THURSDAY, FEBRUARY 19, 1885

A SCIENTIFIC VIEW OF THE COAL QUESTION

IT is well known that our stock of coal is not an infinite quantity, and cannot last an infinite period of time. Different authorities, and those who have investigated the subject, including a Royal Commission, have assigned different lengths of time during which our supply is likely to last; and, according to the most reliable authorities, it cannot be much less than 100 nor much more than 250 years.

Our abundant store of coal, and its application to industrial purposes, has been one of the largest causes of our wealth and progress. The value of coal for those purposes depends essentially upon the fact that it is combustible, and evolves a large amount of heat in burning, and that this heat can be set free at any time and be readily converted into mechanical, chemical, electrical, and other forms of power. As an illustration of the great amount of energy contained in coal, it is well known to scientific men that each piece of it contains sufficient stored-up power to lift its own weight 2300 miles in height, or 2300 times its own weight a mile high. The only other common natural substances to be compared with it in this respect are wood and petroleum, and our stores of these are very small. It is by the expenditure of the energy contained in coal that comparatively valueless iron ore is converted into valuable iron.

It has not been by the mere existence of large quantities of coal in this country, nor entirely by the sale of coal to foreign nations, that so much of our wealth has been obtained, but largely by the circumstance that we were the first nation to apply coal to industrial purposes on a large scale and in a great variety of ways. Other nations also possessing coal, perceiving the great success of this method, followed our example, have overtaken us, and have now rendered it increasingly difficult, year by year, for us to maintain our position as manufacturers.

As also large quantities of coal, petroleum, and inflammable gas are continually being discovered and utilised in other countries, and it is known that the United States of America alone contain nearly forty times as much coal as our entire stock, the time cannot be very far distant when our chances of maintaining even our present position amongst nations by means of our coal will be considerably less than at present. It would be wise, therefore, boldly to face this serious prospect, and consider by what means our national prosperity can be maintained as our coal diminishes in quantity and increases in price, especially as our population is continually increasing, and require to purchase greater supplies of foreign food.

There does exist another and inexhaustible source of wealth and progress, viz. new knowledge obtainable by means of scientific research. It is upon such knowledge, gained by experiments made to examine natural forces and substances, that we must sooner or later depend as a fundamental source of national prosperity. As fast as this knowledge is evolved by discoverers, it is applied in more immediately practical forms by numerous inventors, and then manufacturers and men of business use those practical realities in the production of wealth. This has been the order of events in the past, and will be in the future; this was the way in which we got wealth out of coal. Persons of narrow views on the subject will consider the above proposition vague and unpractical, but this order of things is a great fact and unavoidable; we are the servants of nature, and have no choice in the matter; we might as well hope to live without food as expect to advance in civilisation without the aid of new knowledge.

The practical value of new scientific knowledge as a source of wealth and progress is incomparably greater than that of all the coal-deposits, petroleum springs, and gold-fields of the earth. This great truth, though familiar to scientific investigators, is but little perceived or appreciated by our rulers, or by the mass of their electors; and the chief reason for this is the fact that they possess insufficient knowledge of science. Even Governments can only appreciate that which they understand, and can only act as circumstances and public opinion allow them, and when fettered by an ignorant population, are powerless to preserve a nation from decay.

There cannot be a more complete error than to suppose that new knowledge discovered by means of scientific research is not practical. Its immense practical value has been abundantly proved in a multitude of cases. It was largely by means of such knowledge respecting coal, its properties, constituents, and products, gained by means of experiments, that coal was applied to so many uses. One of the most recent proofs of the practical value of such knowledge is the conversion of the heat of coal into electric current and light in the dynamo-electric machine and electric lamp; the entire existence of these instruments arose from new knowledge discovered in purely scientific researches by Davy and Faraday. It is not necessary to describe here the exact beginnings of gas-lighting, phosphorus-matches, photography, the voltaic-battery, electro-plating, aniline dyes, telegraphy, the telephone, &c.; these, and a multitude of other utilities in common use, had their earliest origin more or less completely, not in the labours of the inventor or of the more directly practical man, but in those of philosophical investigators whose experiments were made with the far more widely practical object, the discovery of new scientific knowledge.

It is not the mere possession of good things, but making the best and earliest use of them that most conduces to success. Our great stock of coal lay comparatively useless as a source of national wealth until philosophical investigators discovered its constituents and properties, and inventors applied these to useful purposes; other nations also possessed coal, and our greater success than theirs was largely and essentially due to the fact that we were the earliest in applying it to important and varied uses. We must not wait, therefore, for those nations to discover for us new knowledge respecting natural forces and substances, but discover it ourselves, in order that we may have the first chance of applying those forces and substances to practical uses, and of offering the useful products for sale or in exchange for food and other commodities.

It is well known that a man who has no faith in medicine will not apply to a physician until death stares him

in the face. Similarly, the average politician and the ordinary elector, having but little knowledge of philosophical experiments, or faith in them, will probably not believe in their great practical value until national distress and panic legislation ensue. The love of money also, and the desire of acquiring it quickly without commensurate sacrifice, fostered by our having so easily obtained it by means of our coal and science, is so strong in this nation, that probably nothing but the actual loss of wealth in the form of diminished value of properties, will induce capitalists and land-owners to perceive and examine the scientific basis of their incomes. When, however, the stern reality of gradually increasing scarcity of coal, and consequent inability to pay for our great supplies of foreign food by means of that coal, and of articles produced by its aid, comes upon us, perhaps the statesmen and wealthy classes of this country will see the indispensable necessity of new scientific knowledge, and be more ready to promote experimental research, with a conviction that its practical results are vast, though not always direct or immediate. G. GORE

MAMMALIAN DESCENT

On Mammalian Descent; the Hunterian Lectures for 1884. By W. Kitchen Parker, F.R.S. (London: Griffin and Co., 1885.)

AS far as we are aware, no attempt has hitherto been made to popularise in any detail the science of comparative embryology. It is therefore indicative of the characteristic originality of Prof. Parker that, on delivering a course of Hunterian lectures upon the embryology of the Mammalia, he should have aimed at charming a popular audience as well as at instructing a scientific one. We confess that upon reading the first paragraphs of his preface, in which he states his intention of handling his subject in a popular way, we felt apprehensive that, like sundry other lecturers with a similar aim and with subjects better suited to the killing of two birds with one stone, he was preparing for himself the misfortune of missing both his marks. But we had not got far into the first lecture without finding that our lecturer very well knew what he was about: he is provided with a double-shotted weapon of the most modern construction, and takes a genuine glee in knocking over some antediluvian tooth-bearing bird on the one side, and the sentimental scruples of a nineteenth-century audience upon the other. And this is done with so much of the vigour of enthusiastic science, as well as the genuine feeling of what we may term unspoiled poetry, that we feel our thanks are due to Miss Arabella Buckley who, it seems, first persuaded Prof. Parker to adopt this delightful method of writing. Moreover, it is obviously to him a natural method. We can everywhere see that he is now writing in the lines of his habitual thinking. The smallest details of his science catch a living glow from the ardour of his imagination, and as this imagination is everywhere charged with biblical thoughts and biblical metaphors, we are led by the force of example to compare it to some quickening spirit which makes all the dry bones of the skulls and skeletons stand up around him as an exceeding great army. Well it is for the cause of evolution that in Prof. Parker it has not only so indefatigable a worker, but likewise so elevated a preacher; and being thus as strong a champion on the side of sentiment as he is on that of science, we have only to congratulate him upon the wisdom of adopting Miss Buckley's advice, and appearing in the lists armed with the weapons of feeling as effectually as with those of fact.

The course consists of nine lectures, and there are, besides, extensive addenda. In the 229 pages to which the book runs, we have presented an excellent epitome of the author's work on the embryology of the Mammalia. The perusal of this epitome cannot fail to strike us anew with admiration at the prodigious amount of his labours, and the great results which they have accomplished. When future generations come to survey the work done by the contemporaries of Charles Darwin in establishing the doctrine of evolution, and in beginning the great task of tracing out the main lines of descent in the animal kingdom, the name of Parker will stand out as one of the most conspicuous of the landmarks.

Two or three quotations from the present volume will serve to convey a general idea of the style, upon which we have laid so much stress. Speaking of a remarkable proboscidian Insectivore, about the size of a rat (*Rhynchocyon cernei*), a ripe embryo of which he has obtained from near Zanzibar, the lecturer says:—

"I have, at present, merely worked out the skull of this valued specimen, but it has rewarded and delighted me more than any kind I have received for a long time past. If nature had triturated together the germs of four or five types of mammals, and had then made this mixture grow, she could scarcely have developed a more curious and composite creature than this long-nosed Insectivore. When Prof. Huxley propounded his oft-quoted theory of the evolution of the Mammalia, he might have known the structure and development of this type by inward sight. Nothing of the kind, however, is ever revealed to biologists in this manner, we only get our facts by opening out the fine folds of organic forms with needle and scissors; we do unroll a good number of the small scrolls, but it is painful and patient work. I am satisfied that no searcher after the evidences of evolution ever saw anything more instructive than what I have found in this small beast. I will make a catalogue of its characters. . . . Thus this greatly specialised kind of Insectivore, whilst retaining the most marked characteristics of the Metatherian skull, takes on two characters, one of which, had it become dominant, would have landed it amongst the Proboscidea, or elephants, whilst the other would have made it a Carnivore. It attempted too much at once, and thus, like a man in doubt, it made but little progress; moreover, in this developmental shilly-shallying, it failed to drop the Marsupial, to take on the new Eutherian, nature, and was thus in danger of going out of being with many of the members of that much-extinguished type. Other types, not thus confused in their ambition, worked out the old strain of Metatherian degradation, and, taking to one definite line of ascent, put on new specialisations in harmony with their surroundings, and to this day their descendants are the rulers of the forest and the field."

Again:—

"Supposing the theory of the slow secular transformation of the old general types into new special types to be true, then the existing mole, in its perfection of adaptive structure, has been as long in coming to its present perfection as the larger and nobler prone or erect types that trample the earth over its head. In its own line, doing its own dark work, it is as complete a creature as the clear-eyed, super-terrestrial types; as a mole, it is con-

summate—a complete and perfect example of a subterranean tyrant; all around him are hosts of juicy grubs and worms, and thereout sucks he no small advantage. Concerning tastes there is no disputing: one naturalist is fond of whales, another of moles, shrews, and mice. All these amusing types must have their supply of food; the great mother, Nature, loves all, and shakes out of her lap plenty for every kind. When we reflect that our country possesses about 1200 species of insects, and that some of the species are prolific beyond all calculation, then we come to understand how the higher insectivorous tribes—birds or small mammals—find so plentiful a table in the wilderness. The hungry, impatient cat, who mistakes a shrew for a mouse, and then leaves her musky prey untasted, would starve upon that which fattens the mole, the shrew, or the bat. The last of these kinds hawks for his small prey, but the shrew, with his delicate proboscis, his sharp eyes, and his quick ears, knows where small beetles most do congregate. These he crunches and munches with exquisite teeth, the cusps or points of which are of a deep ferruginous red colour, more beautiful, strange to say, because they are thus stained. The Power that made the beetle strong in his polished and enamelled armour made also the teeth of the shrew most fit instruments for crushing that armour in which the beetle trusts. It is pleasanter to look upon this vacillation, so to speak, of beneficent purpose from the stand-point of a Darwin than from the stand-point of a Paley; there is much that is painfully mysterious in the whole matter, and we only see it in a partial view."

The lectures concludes thus:—

"When the eyes of the prophet's servant were opened he saw no longer barren rocks with mist resting upon them, but the whole mountain was full of chariots of fire and horses of fire. The vestments and ritual of nature may take up all the attention and use up all the energies of her votaries; these superficial observers fail, however, to find the real religion of nature—the beautiful but awful omnipresence which every flower and every insect reveals. The phenomena of nature are all mere fading pageants, and the really cultivated mind finds lasting satisfaction in meditating upon the recognisable forces that underlie all sensible phenomena.

"This, however, is what the older philosophers called 'dry light,' and is not comfortable to most minds. The deeper things of nature are a sort of manna, but the souls of some people become dried up if you give them merely this celestial kind of diet; so that they murmur and say, 'We remember the fish which we did eat in Egypt, freely; the cucumbers, and the melons, and the leeks, and the onions, and the garlic.'

"And yet this ignorance of nature is set up as a dead wall against all progress of thought; for these people are 'most ignorant of what they're most assured,' certain that they know all about their 'glassy essence'; and, although as blind as moles, they are the enemies of all who have had their eyes opened, to whom the mountain is no longer misty and dark, but flaming with light.

"'Ne sutor supra crepidam'—do not trust the cobbler in things outside his calling—is a proverb that cuts both ways. The biologist may surely be allowed to know things that relate to his own calling: the man who never dreams of life, and the science of life, should be careful how he contradicts its experts. On the other hand, bigotry is not confined to one class of controversialists; some very bitter things have been said by men against faith whose culture and science ought to have taught them better. We have a right to look for nothing but 'sweetness and light' from the apostles and prophets of this new dispensation.

"When the dust of controversy shall have subsided, when those who have to receive new ideas as if by a surgical operation begin to feel the stirrings of these new conceptions thus let into them—the new heaven of nobler thoughts about nature, and of the great First Cause of nature—then all who can think will find that they are colonising a new Atlantis.

"The old song of the creation puts it thus—Evening was—morning was—day one.

"Thus the shadows of the evening came first, and the rosy light of dawn afterwards. Now, in science, even in biological science, the morning is spread upon the mountains, and soaring birds are singing at heaven's gate; so that the drowsiest folk are beginning to stir themselves ere well awake."

We have selected these examples for quotation in order to recommend the book to the class of readers for whom it is primarily intended; but we must not conclude without again observing that the lectures contain so much solid information of the strictly scientific kind, that even the most bigoted of biological experts cannot afford to disregard the material mountain, however little heed they may care to give to the vision of the fiery chariots.

GEORGE J. ROMANES

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Civilisation and Eyesight

IN reading Lord Rayleigh's interesting remarks in NATURE (p. 340) upon Mr. Carter's paper, it has occurred to me that we should not, in considering the question of "aperture," entirely omit the fact that this, though probably following a general rule applicable alike to savages and civilised beings, varies in individual cases. An assistant, who has recently left my observatory, had a singularly "sharp" eye, and could pick up with ease companions to double stars, small satellites, &c., which others saw with difficulty. Such were his powers in this respect that I always appealed to him in the case of a doubtful observation. I noticed one day how large the pupils of his eyes were, so large that I asked him if he had taken anything to artificially dilate them. Subsequent examination proved that they were, though of course varying with the stimulus of light, always much larger than those of most other persons, so much so that I laughingly used to call them "cat's eyes." They had also, in fact, a peculiarity, attributed to feline sight, that he could read fine print and distinguish lines by a light much less bright than I could, and habitually used the gas half turned on, &c. Probably such instances would not be rare if they were looked for. Another question arises on this head: Could it be possible that such a condition of the eye, natural in some persons, could, by certain uses of the member, be fostered in others?

I should not have ventured the suggestion but for having read of the "chamois" eye, by which the habitual, or even casual, Alpine hunter can be recognised. I have no references at hand, and it may be it was the look, and not the eye itself, that gave rise to the cognomen; but if there was any change in the eye-conditions, and especially in that of aperture, we might find a reason why the far-gazing savage improves the power of the eye by use. We know that by certain trades—watch-making, for instance—these conditions are varied adversely to long sight, and in the case of sailors and preventive service men a contrary effect seems induced. Lord Rayleigh thinks that the superiority of the savage is only a question of attention and interpretation of minute details, but when one reads that two distant dots are resolved into distinctly-appreciable personages as regards sex, garments, &c., one begins to suspect that "aperture" must also come into play. At all events an inquiry whether these far-seeing savages have large eye-apertures might help the solution of the matter.

The peculiarity affecting my assistant's eyes may be more

common with the savages than with us, or may have been specially prominent in those selected for experiment.

Gildown, February 16 J. RAND CAPRON

Erosion of Glass

SOME time in the end of 1882 Surgeon-Major Biden, writing from Madras, related in NATURE that certain glass vases on which white-ant mud had been deposited had been eroded over the area of deposit in such a way as to suggest that an acid having, like hydrofluoric acid, a power of dissolving glass, was present in the "mud." On reading this I was reminded of the observations of my teacher, Mr. George Rainey, recently deceased.

Mr. Rainey, in the course of his observations on molecular coalescence, had shown that when carbonate of lime was deposited in spherical forms on the surface of a glass slide in the presence of a strong solution of gum, the glass was eroded at every point of contact of a sphere. He explained the phenomenon, as I believe rightly, by the principle of molecular coalescence. In the embrace of the colloid gum, the molecules of the glass adjoining the spheres were drawn into the spheres, and a little cup corresponded to each sphere-contact. There was certainly no question of the action of an acid, the solutions used being distinctly alkaline.

Inspection of the bottles in which the substances have been kept will show that carbonate of lime, moist or dry, carbonate of potash, moist or dry, chloride of calcium, moist or dry, do not in the absence of colloids erode glass. It appeared to me probable that the white-ant mud must consist of a mixture of some colloid with carbonate of lime or some other salt capable of taking spherical form. I wrote to Surgeon-Major Biden stating the possibility as it appeared to me, and suggesting that the mud should be examined as regarded colloid and earthy matter. He replied most courteously that the mud was not at the time to be obtained, but sent some of the earth which formed its basis.

Experimenting with this earth alone, I was not able to etch glass. But in view of some interesting speculations which this episode started for me, I have since made some experiments directly bearing on the possibility of the erosion of glass surfaces by saline matters of alkaline reaction deposited on them within a colloid bed or matrix.

I inclose for your inspection a glass slide which has been so treated. More than a year ago this slide was coated with a layer of paraffin, melted on. The word "Ant" was drawn on the side with a wood point, in the expectation that etching might be effected where the paraffin was removed, the wood point being incapable of scratching the glass. The expectation was not entirely fulfilled. The paraffin, not being sticky enough, scaled off in sheets so as to leave the whole surface ultimately exposed. This whole surface is now seen to be etched. At first sight the glass looks as if it were covered with a semi-opaque deposit. But it has been boiled in hydrochloric acid and in water, without any change becoming evident, and under the microscope the appearance rendered is clearly an appearance of erosion.

The details of the experiment were as follows: a strong solution of gum arabic in distilled water was made and filtered. It was divided into two portions. To one was added a small quantity of chloride of calcium, to the other a small quantity of carbonate of potash. A wide-mouthed bottle, three inches in height, was half filled with the first solution, and the second solution was slowly poured on the top of the first, so as to avoid mixture of the two. The slide, prepared, as already described, was placed vertically in the bottle, so that the middle region of the slide corresponded to the level of the meeting of the two solutions.

The slide was found, at the end of a twelvemonth, denuded of its paraffin, and coated with an incrustation of carbonate of lime most dense at and near the meeting level of the two solutions.

Under the microscope the surface of the slide presents many kinds of erosion—spherical, linear, and intermediate. But in proportion as higher and higher objectives are used, all the appearances are shown to be of circular form, the lines, for instance, being resolved into lines of circular pits.

I dare not make this letter too long, and therefore include in it only so much as bears on Surgeon-Major Biden's most interesting communication. It suffices, at the moment, to indicate that the surface of a glass slide may be eroded in a way to suggest the action of an acid, such as hydrofluoric acid, when no free acid is present; and that erosion may occur when the glass is brought in contact with alkaline fluid, a colloid, and crystalline substances capable of assuming, in the presence of a colloid, spheroidal form.

I propose to state the results of this and other experiments, and some speculations suggested thereby, before the Royal Microscopical Society. WILLIAM M. ORD

7, Brook Street, W.

Echium Crossing

THE gardens of Madeira are remarkable for the neglect of native plants. This is due in part to indigenous indifference, and also to a preference for familiar forms amongst people who migrate hither from various regions, though chiefly to the temptation to test the facilities of growth and naturalisation in a moist and equable sub-tropical climate. Hence it is often easier to import species peculiar to Madeira than to find them in their native place; but none the less do these rocks abound with conspicuous examples of interesting genera.

I have cultivated for many years two large echiums upon the terraces of the Luinta do Valle, 300 feet above the sea, namely, *E. fastuosum*, the Madeiran littoral species, a perennial shrub 3 or 4 feet high, with hairy light green leaves and branching stems crowded with scorpioid racimes of light-blue flowers with white stamens. And secondly, *E. simplex*, the giant Canarian species maturing in Madeira in the second year. This remarkable plant has large, smooth, silvery leaves, and terminates its growth in one unbranched stem densely packed with folded flower-stalks bearing pure white blossoms, and forming a pyramid reaching sometimes 14 feet in height. *E. simplex* dies after flowering. The flowers in both species last from three to five weeks, and the unfolded flower-stalks measure 2 to 3 inches in length.

Until 1882 the two echiums, though growing together and having their scentless flowers freely visited by bees and insects for their abundant nectar, had remained distinct; but, in 1883, after introducing a swarm of Ligurian bees from England, I found that a cross-fertilisation had been effected, which has left me very few examples of *E. simplex*.

The hybrid Echium possesses the leaves of the giant plant, and the stem merely bifurcates or branches sparingly. The flowers are tinged light blue, and the perennial habit of *E. fastuosum* is expressed by a continual growth of the flower racimes, which, after flowering for two years, measure 26 inches in length, and are still unfolding. The seeds of this hybrid have not germinated.

I am now preparing to effect a cross between *E. simplex* and the handsome mountain *E. candicans* of this island at my country residence, 2000 feet above the sea.

E. candicans and *E. fastuosum* have frequently blended, producing plants less new in structure than in habit; but such hybrids have been quickly lost, either in sterility or reversion.

Madeira, January 26 MICHAEL GRABHAM

[This is an interesting case of the spontaneous appearance of a hybrid between two very distinct species. The occurrence of such hybrids is frequent in some genera, such as *Verbascum* and *Primula*, and gives systematic botanists much trouble. There is a striking picture of *Echium simplex* at Teneriffe, in the North Gallery at Kew, No. 23.—ED.]

The Iridescent Clouds

THE coloured fringes and bows described by Mr. N. in Prof. C. Piazzi Smyth's communication (p. 316) are clearly of a totally different character from the iridescent clouds that were so widely remarked in December. I take the "fringes and bows in circles" mentioned by him to be simply the same phenomenon of coloured circles that is so often seen around the moon, which goes by the name of a "corona"; and the reason why it is not easily seen around the sun, except by reflection in glass or water, is that the sun is too dazzling to look at directly. There is another phenomenon of coloured clouds which is probably also alluded to by Mr. N., and that is when thin clouds, usually cirrus, show interference colours, often very vividly; the positions of these colours evidently depending on the structure of the clouds, and being quite irregular with reference to the sun. The iridescent clouds recently observed no doubt owe their colour to the same cause, but the kind of cloud was evidently different, and the colours produced were much more striking. The clouds themselves were quite recognisable as

being of a peculiar type, even when too far from the sun to show any colour. The clouds thus coloured are usually of a much striated or rippled structure, and show the colours generally in small spectra; whereas the clouds seen in December were remarkably smooth in texture, and although often striated, the striations were feeble and comparatively few, and in straight lines, while each cloud showed one regular gradation of colour.

Whether the coloured clouds described by your correspondents, with the exception of those mentioned by Mr. N., were all of the same kind, it is difficult to decide; perhaps they may have been so, in spite of the varieties in their appearance. Some observers describe the body of these clouds as having been dark, in particular your correspondents at Darlington and Broseley (Shropshire), pp. 192, 193, whereas all seen here were white or bright. Still, those clouds seen further south were probably of the same kind, only thicker. The difference in shape is most likely not a radical one, as the larger clouds seen here had wavy, not straight, edges, though their general directions were the same as the sides of the more rectangular ones. The nearest approach here to a pallium of these singular clouds was on the morning of December 12, when there occurred, at 8.15 a.m., an extensive pale steel blue film above the region where the sun was, and reaching to an altitude of 25°.

Dr. H. Geelmuyden, observing at Christiania on December 8 (see p. 264), appears to place the peculiar clouds at a lower level than cirro-cumulus, but as seen here they were always the highest clouds.

In conclusion, I think that Prof. A. S. Herschel is mistaken in supposing these clouds have been "only a good instance of a common sight," but although I never noticed them before, I do not dispute the suggestion of Dr. Geelmuyden that they may be seen more frequently than some of us have thought. I have not seen them since December 13. T. W. BACKHOUSE

Sunderland, February 11

Human Hibernation

I DID not answer your correspondent's query on human hibernation in your issue of the 5th inst. (p. 316), because I thought some one better informed than myself would answer it. However, as no one has done so, I may as well give a solution of this well-known Indian trick which I have seen, but the authority for which, I am sorry to say, I cannot remember. It is very simple, like all these things are when you "know how they are done." A tunnel is dug from the grave to the neighbouring jungle; the grave itself is partly prepared. The subject is then, in sight of the spectators, prepared, by having his ears and nostrils filled with wax, and his tongue turned back. He is then apparently buried, creeps through the tunnel, and gets away. After six months, or any other interval, he creeps back again, is dug up apparently lifeless, and restored with infinite pains. In some cases, I believe, a sentry has been placed over the grave, but, of course, without results

ALFRED H. HULK

Bolney House, Ennismore Gardens, S.W., February 13

An Error in Ganot's "Physics"

I BEG to call attention to a typical error in a formula which appears to have run through ten editions of Ganot's well-known treatise. It is one not difficult of discovery by that somewhat too rare class of students who carefully plod through all the steps which lead up to it, but very likely to be overlooked by the more common class who are content to extract the formula as it stands with the undoubting faith reasonably based on "Tenth Edition, revised and enlarged."

The formula which represents the weight of air saturated with vapour occurs on p. 325 of the tenth edition, and is printed—

$$P = \frac{0{\cdot}31 \times V.F}{(1 + \alpha t)\,760}\,(H - \tfrac{5}{8}F).$$

The first F should obviously be expunged.

E. DOUGLAS ARCHIBALD

Tunbridge Wells, February 16

Shadow on Clouds

I AM not aware if the following phenomenon is at all common, but I venture to think it somewhat unusual, and that it might interest some of your readers:—

Whilst at anchor in Cumberland Bay in the Island of Juan Fernandez on the evening of December 24, 1884, we observed the following remarkable sight. The Bay is situated on the north side of the island, and some way inland is a remarkable hill, called the "Yunkua," or "anvil," it being somewhat of the shape of one; it is the highest hill in the place, viz. 3005 feet, and from the anchorage bears about south-west, and is distant two miles. The Bay is closed in by high cliffs and hills. On the day mentioned, shortly after the sun had disappeared behind the western hills, we observed this hill make a distinct shadow on the clouds above it, in which every irregularity and peak came out with wonderful clearness. The shadow lasted till about 30″ before the time of sunset (which was invisible to us), and was inverted and inclined to the hill as in a mirage at about 30°. The weather at the time was very fine. Barometer, 30·22; temperature of altitude thermometer, F. 62°; and very few clouds were about. ALFRED H. TARLETON

H.M.S. *Constance*, at Sea, January 25

THE METEOROLOGY OF HAVANA[1]

THIS annual of the Royal College of the Society of Jesus at Havana for 1875, which has just been published, possesses more than a passing interest. The observations were made daily every two hours from 4 a.m. to 10 p.m., and include pressure, temperature, humidity, wind, rain, magnetic, electric, optical, and other weather phenomena. The results are plotted on large monthly diagrams, and as each day has six-tenths of an inch devoted to it, the two-hourly observations of all the different elements can be readily seen and compared with each other; and this part of the work is done with a scrupulous care and accuracy it would not be easy to surpass. On the same diagrams are marked the days on which auroras are reported to have been observed in the United States, as published in the *Monthly Weather Review* at Washington.

A note is appended to each month's observations, drawing attention to the more significant of the magnetic perturbations in their relations to the changes of weather at the time, and in particular to the "nortes," or "northers," of the cooler months of the year. Thus, on April 3, 4, and 5 a "norther" prevailed, which was succeeded on the three following days by a remarkable magnetic perturbation, which was accompanied with a high barometer and a strong wind, rising in the afternoons to a rate of 35 kilometres per hour, with daily manifestations of aurora in the United States, but was unaccompanied throughout with any electric phenomena. Again, the magnetic perturbation, of April 13 was coincident with a characteristic "norther," much thunder and lightning, a very heavy rainfall, and a disposition and state of the aqueous vapour which give rise to solar and lunar halos, and other optical effects; but during the time no auroras were reported from the United States. Father Viñes points out in the monthly notes various other relations between the magnetical and meteorological phenomena which suggest that this line of inquiry is likely to lead to valuable additions to our knowledge of weather changes.

The mean annual pressure at sea-level is 30·067 inches, the maximum being 30·129 inches in January and the minimum 30·002 inches in September, with a secondary maximum of 30·092 inches in July and minimum of 30·066 inches in April. As regards the diurnal oscillation from the morning maximum to the afternoon minimum, the greatest occurs in the winter months, when it amounts to 0·080 inch, whereas in July it is only 0·051 inch. These diurnal and seasonal fluctuations in their varying amounts have no small significance in their relations to the analogous phenomena in the United States and over the high pressure area of the Atlantic. The mean annual temperature is 77°·7, rising to the maximum 82°·2 in July, and falling to the minimum 73°·0 in December. The

[1] "Observaciones Magnéticas y Meteorólogicas del Real Colegio de Belen de la Compañia de Jesus en la Habana. Año de 1875." (Habana, 1884.)

absolutely highest temperature, 98°·8, occurred at 4 p.m. on July 30 under very striking circumstances. For four days previously auroras had been observed in the United States; the magnetic and electrical conditions showed marked disturbances at Havana; atmospheric pressure, which had been low, began to rise on the 30th, on which day, at 2 p.m., the relative humidity fell to 45, but rose four hours after to 84. The temperature, which at 4 p.m. was 93°·8, thereafter instantly and rapidly fell, and by 6 p.m had fallen to 78°·8. The lowest temperature for the year, 55°·9, occurred at 6 a.m. on December 16, at the termination of a "norther," which overspread the sky with cirri, attended with solar and lunar halos; and was immediately followed by a low barometer, remarkable hygrometric changes and irregularities in the direction and velocity of the wind.

Excepting a greater tendency to southing during the warmer months, the wind varies little in direction from month to month. The diurnal variation is interesting. From 10 p.m. to 8 a.m. it is E. by S.; at 10 a.m. E. by N.; from 10 a.m. to 2 p.m. N.N.E.; 4 p.m. N.E.; 6 p.m. E.N.E.; and at 8 p.m. E., thus showing in a marked manner the influence of the sea breeze at Havana. The daily changes in the wind's velocity are very large. The minimum occurs from 4 to 6 a.m., and the maximum from noon to 4 p.m., the maximum velocity being four times greater than the minimum. The strongest winds occur in April, and the weakest in November; the winds in April blowing with double the velocity of those in November. As regards direction, the strongest winds are the sea winds which blow from N.N.E. and E., and the weakest the land-winds from E.S.E., S.E., and S.W., the former blowing with double the force of the latter.

The annual curve of thunderstorms is a very decided one. Of the eighty recorded during 1875, sixty-five occurred during the five months from May to September, and only three during the four months from January to March and December. The annual rainfall was 42·39 inches, about half of the whole amount falling in August and September, during which time 20·61 inches fell. Only a quarter of an inch fell in December, and half an inch in November. The total evaporation for the year was about 60 inches, the maximum, 6·92 inches, being in April, when the air is driest and the winds strongest, and the minimum 3·60 inches in September, October, and November, when the air is most highly saturated and the force of the wind least. As regards the occurrence of rain at different periods of the day, more than 50 per cent. of the whole hours during which rain is noted to have fallen were between noon and 6 p.m., thus closely associating the rainfall with the diurnal period of the thunderstorms. The almost total absence of the thunderstorm from the rains of the winter months, as compared with the summer months, when lightning, or some other electric phenomenon occurs almost daily, is an important feature in the climate of Havana from its bearing on the theory of the thunderstorm.

THE WHALE EXHIBITION IN HAMBURG

DURING the autumn of last year an exhibition of considerable novelty and interest to zoologists was held in Hamburg, embracing complete skeletons, parts, and craniæ of whales, products of the same, and apparatus used for catching these greatest organisms of the world from the earliest times to the present day.

The suggestion for this exhibition came from the writer of these lines, who offered to exhibit three of the greatest fin-whale skeletons in existence. Dr. H. Bolau, director of the Zoological Gardens in Hamburg, succeeded, in spite of many obstacles, in arranging this exhibition and collecting interesting and valuable material, towards which Prof. Pagenstecher, director of the Natural History Museum, also contributed greatly by arranging the exhibits and obtaining several rare specimens acquired by the German Expedition of 1882-83 to South Georgia. In this part were also some splendid water-colour drawings from this island, executed by Herr Mostlaff, which were greatly admired.

The exhibition, which was divided into four parts, viz. one for the whale fauna, one for the hunting-gear, one for the whale products, and one historic-ethnographical, took place partly in the open, partly in a hall.

In the first section, naturally, the Cetaceæ, were most prominent, these monsters being mounted in the Gardens. Of true Balænidæ, the Hamburg Zoological Museum exhibited a cranium of *Balæna mysticetus*, L., a very fine specimen. Otherwise the Balænopteridæ, or fin-whales, were most numerous, there being four different species of this family. The most imposing of them all was the skeleton of the "blue" whale (*Balænoptera sibbaldii*, Gray), the greatest animal on earth. It measured 75 feet in length, and was mounted in its natural position. The specimen seemed to have been full grown, as no division between the epiphyse and the vertebral body could be discovered. As an individual osteological curiosity may be mentioned that the jugal bone consisted of two bones, a smaller and a larger piece, which are closely united by strong ligaments.

Not far from this specimen stood the skeleton of the common fine-whale (*Balænoptera musculus*, Companyo), 63 feet long, which was, as Prof. Flower describes it, "in adolescent state." The greater part of the thoracic and lumbal vertebræ showed distinct separation between the epiphyses and the vertebral body, which was also the case with the limbs. Although the length between these two species is not so very great, there is a marked difference between their structure. The fine-whale is remarkable for its lightness and elegance; in proportion to its great length, some parts of the skeleton seem indeed quite fragile, whereas the blue whale shows throughout in its structure a massiveness bespeaking enormous muscular powers. The difference became even more striking when the fin-whale was compared with a third species, the *Megaptera boops*, O. Fabr. This skeleton was 54 feet long, and therefore a large individual, and was found dead at sea between the coasts of Norway and Russia. From the complete development of the ossification and coalescence of epiphyses with the vertebral bodies and respective diaphyses of the extremities it was clearly a full-grown animal. It gives an impression of heaviness, on account of the short, thick bones and the great length of the fore-limbs, 14-15 feet, which is very apparent. To this individual belongs the whale-bone complex, part of which was shown. Near the same a cranium of this species of whale was exhibited with a complete whale-bone complex. This was a very fine specimen, and was prepared for the Museum of Natural Sciences at Stuttgart, where it now is.

The above-mentioned skeletons and crania were prepared by me in 1883 at the whaling establishments at Vardö (lat. 70½° N.), but the three skeletons, which were, I may be permitted to say, very complete and fine specimens, I had steamed and finished in Hamburg.

In the open, too, there was mounted a skeleton of *Balænoptera rostrata*, Fabr., the smallest of all fin-whales; but this specimen left much to be desired in the way of completeness and finish. It was, however, interesting by its history and age, and is perhaps the oldest Cetacea in any museum. For 200 years it has been instated in the town hall at Bremen, where there is an inscription on the wall to the effect that the animal stranded at Bremerhafen on May 9, 1669, whence it was brought to Bremen, and the skeleton accorded the above-mentioned honour.

As representative of the great "tooth' whales, there was the lower jaw of a spermaceti whale belonging to an

individual which, in 1849, was taken at the Canary Islands.

Dr. Bolau had drawn some very interesting maps showing the habitat of the Greenland whale, the Antarctic whale, the blue, and the spermaceti whales, which were greatly admired.

One of the most valuable exhibits was, however, the cranium of a narwhale (*Monodon monoceros*, L.) with two tusks. It was brought to Hamburg from Greenland in 1684. There are, I believe, at present in Europe only a dozen such craniæ, among which the one exhibited here is certainly the oldest. The most remarkable feature about this cranium is, however, if the inscription attached can be relied on, that it is that of *a female*. The tusk is, as is generally known, never developed in the females. The description is accompanied by a drawing of the whale and a young one, stated to be the offspring of the former. It is, nevertheless, hardly possible to accept this statement, at variance with all experience.

In addition to tusks of narwhals, skeletons and stuffed specimens of other kinds of tooth-whales were exhibited, as, for instance, of *Orca gladiator*, *Delphinus delphis*, *Phocæna communis*, *D. tursio*, and a cranium of bottle-nose *Hyperoodon latifrons*, Gray, which, according to the latest researches, is only the male of *H. diodon*.

Of the fœtus exhibited I may mention those of *Balænoptera rostrata*, Fabr., *Rhinodelphis leucoplevrus*, Rasch., and one of *Megaptera boops*, Fabr., only 12 inches long, exhibited by the writer.

Besides the exhibits belonging to the order of Cetaceæ, there were some fine specimens of *Sirenia*, as *Manatus* and *Halicore*, skeletons as well as stuffed animals, exhibited by the University of Kiel. There were, further, a fine collection of seals, of which I shall, however, only mention *Otaria Godeffroy*, from the coast of Peru. As some of the greatest curiosities, should be added, a perfect stuffed specimen of the sea-elephant, 11 feet long, and two sea-leopards from South Georgia.

The exhibition was visited by a considerable number of zoologists, and may, in every respect, be said to have been a success. G. A. GULDBERG

The Zootomical Museum, Christiania

CHESTER NEW MUSEUM

THE foundation-stone of this museum was laid on February 5 by the Duke of Westminster, K.G. We have previously referred to the work done by the Chester Natural Science Society, and the Archæological Society, whose joint museum is now to be placed in a permanent building, uniting under one roof accommodation for it, an art gallery, and every provision for Science and Art Department classes. The remains of ancient Chester, which came to light from time, found their way to the British Museum up to the year 1849, when the Rev. W. H. Massie, the Rector of St. Mary's-on-the-Hill, called a meeting to consider the formation of a museum, and a society was formed for "the illustration and preservation of the remains of antiquity and other objects of interest in the city and in the county." The Society's "collection" was first housed in a cupboard at the Commercial Buildings; thence it was removed, first, to the Episcopal Palace in Abbey Square, afterwards to a house in Lower Bridge Road, to join the Museum of the Natural Science Society, whose collections are of considerable extent and essentially local in character, thanks to the marked love of nature and zeal for scientific research infused into many of the Chester citizens by the founder of the Society, the late Canon Kingsley, and the admirable rules for directing local investigation by which the Society is governed. Under the presidency of Prof. McKenny Hughes, the Society remains as vigorous as ever, as is the Archæological Society under that of Dean Howson, who, since the failing health of Mr. Thomas Hughes, F.S.A., to whom great credit is due, has taken an active interest in the Society, and in 1882 became the chairman of a joint committee to secure a building to answer all the requirements of science and art in Chester. This Committee selected a site in the Grosvenor Road, the greater part of which was at once placed at their disposal by the Duke of Westminster, who, moreover, headed the subscription list with the munificent sum of 4000*l.*, to which the Committee have since received promises of sums amounting to a further 3500*l.*

The architect is Mr. Thos. M. Lockwood, of Chester; the tender for the erection of the work accepted by the Committee is for 8150*l.* The elevation of the building, with its octagonal turret, with lantern surmounted by a quaint ogee roof, surmounting a steep-pitched roof, suggests the municipal architecture of Holland. The joint library and reading room is 21 feet by 19; the natura history museum is 36 feet by 25; the lecture theatre 44½ feet by 30; the art and archæological gallery is 60 feet by 23; on the first floor are science class rooms; on the second those for art. Space is reserved for future extensions in all departments.

Prof. McKenny Hughes stated the object of the Museum to be three-fold, being "intended for teaching, for study, and for exhibition. We have long carried on teaching in this old city in connection with the societies which have for their object the study of natural science, but that is to be extended. We have already extended it by putting ourselves in connection with the teaching powers of South Kensington, and now we will bring this into shape and have class-rooms and teachers definitely appointed to carry on the work which has been so nobly taken up by your citizens. The Duke has mentioned already that he felt that a great deal of the work had been done by the enterprise of the citizens. Well, that is the work which we intend to carry on in the teaching departments of this institution; but it is also intended for study. The world is going on fast in the direction of knowledge. Every one is trying to acquire knowledge which shall be turned to money, or which shall be pursued for its own sake, or which will add to the comfort of the community. In all these directions we hope to assist. Men may come in here and study in the library, or in the laboratories, or in the museum."

At the subsequent dinner the chairman, the Dean of Chester, stated that Canon Kingsley gave impulse to the study of natural history in this place, which has by no means lost its momentum. What the Duke of Westminster has said concerning the deep interest taken today in scientific subjects is most strictly in harmony with the facts of the case. There is here, deeply-rooted in the minds of many, a determined love for science of this kind, which is the best possible augury for benefits to result from our museum.

Sir Philip Cunliffe Owen, K.C.M.G., C.B., responding for art, said, "this is a museum after my own heart, for I think it corresponds entirely with what was in the mipd of the Prince Consort when he established the Science and Art Department and the South Kensington Museum. It was a part and parcel of his scheme that the teaching and the examples should be under one roof, and it has been found that the example of the Science and Art Department, combined as it is with one of the finest art museums in the world, and combined as it will be, I hope, in the near future with one of the finest science museums that may be created, has done more good, not only in this country, but throughout the world, than anything else which had been thought of before. When we think of the museums of the past, we know that they could not speak for themselves; they were examples, but however interesting and however ancient they might have been, they had no speaking powers, because they were not in combination with a teaching organisation."

CHAS. E. DE RANCE

THE CLASSIFICATION OF THE VARIETIES OF THE HUMAN SPECIES.[1]

THE most ordinary observation is sufficient to demonstrate the fact that certain groups of men are strongly marked from others by definite characters common to all members of the group, and transmitted regularly to their descendants by the laws of inheritance. The Chinaman and the Negro, the native of Patagonia and the Andaman Islander, are as distinct from each other structurally as are many of the so-called species of any natural group of animals. Indeed it may be said with truth that their differences are greater than those which mark the groups called genera by many naturalists of the present day. Nevertheless, the difficulty of parcelling out all the individuals composing the human species into certain definite groups, and of saying of each man that he belongs to one or other of such groups is insuperable. No such classification has ever, or indeed, can ever, be obtained. There is not one of the most characteristic, most extreme forms, like those I have just named, from which transitions cannot be traced by almost imperceptible gradations to any of the other equally characteristic, equally extreme, forms. Indeed, a large proportion of mankind is made up, not of extreme or typical, but of more or less generalised or intermediate, forms, the relative numbers of which are continually increasing, as the long-existing isolation of nations and races breaks down under the ever-extending intercommunication characteristic of the period in which we dwell.

The difficulties of framing a natural classification of man, or one which really represents the relationship of the various minor groups to each other, are well exemplified by a study of the numerous attempts which have been made from the time of Linnæus and Blumenbach onwards. Even in the first step of establishing certain primary groups of equivalent rank there has been no accord. The number of such groups has been most variously estimated by different writers from two up to sixty, or more, although it is important to note that there has always been a tendency to revert to the four primitive types sketched out by Linnæus, the European, Asiatic, African, and American, expanded into five by Blumenbach by the addition of the Malay, and reduced by Cuvier to three by the suppression of the two last. After a perfectly independent study of the subject, extending over many years, I cannot resist the conclusion, so often arrived at by various anthropologists, and so often abandoned for some more complex system, that the primitive man, whatever he may have been, has in the course of ages divaricated into three extreme types, represented by the Caucasian of Europe, the Mongolian of Asia, and the Ethiopian of Africa, and that all existing individuals of the species can be ranged around these types, or somewhere or other between them. Large numbers are doubtless the descendants of direct crosses in varying proportions between well-established extreme forms; for, notwithstanding opposite views formerly held by some authors on this subject, there is now abundant evidence of the wholesale production of new races in this way. Others may be the descendants of the primitive stock, before the strongly marked existing distinctions had taken place, and therefore present, though from a different cause from the last, equally generalised characters. In these cases it can only be by most carefully examining and balancing all characters however minute, and finding out in what direction the preponderance lies, that a place can be assigned to them. It cannot be too often insisted on, that the various groups of Mankind, owing to their probable unity of origin, the great variability of individuals, and the possibility of all degrees of intermixture of races at remote or recent periods of the history of the species, have so much in common that it is extremely difficult to find distinctive characters capable of strict definition, by which they may be differentiated. It is more by the preponderance of certain characters in a large number of members of a group, than by the exclusive or even constant possession of these characters in each of its members, that the group as a whole must be characterised.

Bearing these principles in mind, we may endeavour to formulate, as far as they have as yet been worked out, the distinctive features of the typical members of each of the three great divisions, and then show into what subordinate groups each of them seems to be divided.

To begin with the Ethiopian, Negroid or Melanian, or "black" type. It is characterised by a dark, often nearly black, complexion; black hair, of the kind called "frizzly" or, incorrectly, "woolly," *i.e.* each hair being closely rolled up upon itself, a condition always associated with a more or less flattened or elliptical transverse section; a moderate or scanty development of beard; an almost invariably dolichocephalic skull; small and moderately retreating malar bones (mesopic face[1]); a very broad and flat nose, platyrhine in the skeleton; moderate or low orbits; prominent eyes; thick, everted lips; prognathous jaws; large teeth (macrodont); a narrow pelvis (index in the male 90 to 100); a long fore arm (humero-radial index 80), and certain other proportions of the body and limbs which are being gradually worked out and reduced to numerical expression as material for so doing accumulates.

The most characteristic examples of the second great type, the Mongolian or Xanthous or "yellow," have a yellow or brownish complexion; coarse, straight hair, without any tendency to curl, and nearly round in section, on all other parts of the surface except the scalp, scanty and late in appearing; a skull of variable form, mostly mesocephalic (though extremes both of dolichocephaly and brachycephaly are found in certain groups of this type); a broad and flat face, with prominent, anteriorly-projecting malar bones (platyopic face); nose small, mesorhine or leptorhine; orbits high and round, with very little development of glabella or supraciliary ridges; eyes sunken, and with the aperture between the lids narrow; in the most typical members of the group with a vertical fold of skin over the inner canthus, and with the outer angle slightly elevated; jaws mesognathous; teeth of moderate size (mesodont); the proportions of the limbs and form of the pelvis have yet to be worked out, the results at present obtained showing great diversity among different individuals of what appear to be well-marked races of the group, but this is perhaps due to the insufficient number of individuals as yet examined with accuracy.

The last type, which, for want of a better name, I still call by that which has the priority, Caucasian, or "white," has usually a light-complexioned skin (although in some, in so far aberrant cases, it is as dark as in the Negroes); hair fair or black, soft, straight, or wavy, in section intermediate between the flattened and cylindrical form; beard fully developed; form of cranium various, mostly mesocephalic; malar bones retreating; face narrow and projecting in the middle line (pro-opic); orbits moderate; nose narrow and prominent (leptorhine); jaws orthognathous; teeth small (microdont); pelvis broad (pelvic index of male 80); forearm short, relatively to humerus) (humero-radial index 74).

In endeavouring further to divide up into minor groups the numerous and variously-modified individuals which cluster around one or other of these great types, a process quite necessary for many practical or descriptive purposes, the distinctions afforded by the study of physical characters are often so slight that it becomes necessary to take other considerations into account, among which geographical distribution and language hold an important place.

I. The Ethiopian or Negroid races may be primarily divided as follows:—

A. African or typical Negroes—inhabitants of all the

[1] From the President's Anniversary Address to the Anthropological Institute of Great Britain and Ireland, Jan. 27, 1885.

[1] Oldfield Thomas, in a paper read before the Anthropological Institute, Jan. 13, 1885.

central portion of the African continent, from the Atlantic on the west to the Indian Ocean on the east, greatly mixed all along their northern frontier with Hamitic and Semitic Melanochroi, a mixture which, taking place in various proportions and under varied conditions, has given rise to many of the numerous races and tribes inhabiting the Soudan.

A branch of the African Negroes are the Bantu—distinguished chiefly, if not entirely, by the structure of their language. Physically indistinguishable from the other negroes where they come in contact in the Equatorial regions of Africa, the Southern Bantu, or Kaffirs, as they are generally called, show a marked modification of type, being lighter in colour, having a larger cranial capacity, less marked prognathism, and smaller teeth. Some of these changes may possibly be due to crossing into the next race.

B. The Hottentots and Bushmen form a very distinct modification of the Negro race. They formerly inhabited a much larger district than at present; but, encroached upon by the Bantu from the north and the Dutch and English from the south, they are now greatly diminished, and indeed threatened with extinction. The Hottentots especially are much mixed with other races, and under the influence of a civilisation which has done little to improve their moral condition, they have lost most of their distinctive peculiarities. When pure-bred they are of moderate stature, have a yellowish-brown complexion, with very frizzly hair, which, being less abundant than that of the ordinary negro, has the appearance of growing in separate tufts. The forehead and chin are narrow, and the cheek-bones wide, giving a lozenge shape to the whole face. The nose is very flat, and the lips prominent. In their anatomical peculiarities, and almost everything except size, the Bushmen agree with the Hottentots; they have, however, some special characters, for while they are the most platyrhine of races, the prognathism so characteristic of the negro type is nearly absent. This, however, may be the retention of an infantile character so often found in races of diminutive stature, as it is in all the smaller species of a natural group of animals. The cranium of a Bushman, taken altogether, is one of the best marked of any race, and could not be mistaken for that of any other. Their relation to the Hottentots, however, appears to be that of a stunted and outcast branch, living the lives of the most degraded of savages among the rocky caves and mountains of the land of which the comparatively civilised and pastoral Hottentots inhabited the plains.

Perhaps the Negrillos of Hamy, certain diminutive round-headed people of Central and Western Equatorial Africa, may represent a distinct branch of the Negro race, but their numbers are few, and they are very much mixed with the true Negroes in the districts in which they are found. They form the only exceptions to the general dolichocephaly of the African branch of the Negro race.

C. *Oceanic Negroes* or *Melanesians.*—These include the Papuans of New Guinea and the majority of the inhabitants of the islands of the Western Pacific, and form also a substratum of the population, greatly mixed with other races, of regions extending far beyond the present centre of their area of distribution.

They are represented, in what may be called a hypertypical form, by the extremely dolichocephalic Kai Colos, or mountaineers of the interior of the Fiji Islands, although the coast population of the same group have lost their distinctive characters by crossing. In many parts of New Guinea and the great chain of islands extending eastwards and southwards ending with New Caledonia, they are found in a more or less pure condition, especially in the interior and more inaccessible portions of the islands, almost each of which shows special modifications of the type recognisable in details of structure. Taken altogether their chief physical distinction from the African Negroes lies in the fact that the glabella and supra-orbital ridges are generally well developed in the males, whereas in Africans this region is usually smooth and flat. The nose, also, especially in the northern part of their geographical range, New Guinea, and the neighbouring islands, is narrower (often mosorhine) and prominent. The cranium is generally higher and narrower. It is, however, possible to find African and Melanesian skulls quite alike in essential characters.

The now extinct inhabitants of Tasmania are probably pure, but aberrant, members of the Melanesian group, which have undergone a modification from the original type, not by mixture with other races, but in consequence of long isolation, during which special characters have gradually developed. Lying completely out of the track of all civilisation and commerce, even of the most primitive kind, they were little liable to be subject to the influence of any other race, and there is in fact nothing among their characters which could be accounted for in this way, as they are intensely, even exaggeratedly, Negroid in the form of nose, projection of mouth, and size of teeth, typically so in character of hair, and aberrant chiefly in width of skull in the parietal region. A cross with any of the Polynesian or Malay races sufficiently strong to produce this, would, in all probability, have also left some traces on other parts of their organisation.

On the other hand, in many parts of the Melanesian region there are distinct evidences of large admixture with Negrito, Malay, and Polynesian elements in varying proportions, producing numerous physical modification In many of the inhabitants of the great island of New Guinea itself and of those lying around it this mixture can be traced. In the people of Micronesia in the north, and New Zealand in the south, though the Melanesian element is present, it is completely overlaid by the Polynesian, but there are probably few, if any, of the islands of the Pacific in which it does not form some factor in the composite character of the natives.

The inhabitants of the continent of Australia have long been a puzzle to ethnologists. Of Negroid complexion, features, and skeletal characters, yet without the characteristic frizzly hair, their position has been one of great difficulty to determine. They have, in fact, been a stumbling-block in the way of every system proposed. The solution, supported by many considerations too lengthy to enter into here, appears to lie in the supposition that they are not a distinct race at all, that is, not a homogeneous group formed by the gradual modification of one of the primitive stocks, but rather a cross between two already-formed branches of these stocks. According to this view, Australia was originally peopled with frizzly-haired Melanesians, such as those which still do, or did till the recent European invasion, dwell in the smaller islands which surround the north, east, and southern portions of the continent, but that a strong infusion of some other race, probably a low form of Caucasian Melanochroi, such as that which still inhabits the interior of the southern parts of India, has spread throughout the land from the north-west, and produced a modification of the physical characters, especially of the hair. This influence did not extend across Bass's Straits into Tasmania, where, as just said, the Melanesian element remained in its purity. It is more strongly marked in the northern and central parts of Australia than on many portions of the southern and western coasts, where the lowness of type and more curly hair, sometimes closely approaching to frizzly, show a stronger retention of the Melanesian element. If the evidence should prove sufficiently strong to establish this view of the origin of the Australian natives, it will no longer be correct to speak of a primitive Australian, or even Australoid, race or type, or look for traces of the former existence of such a race anywhere out of their own land. Proof of the origin of such a race is, however, very difficult, if not impossible, to obtain, and

I know nothing to exclude the possibility of the Australians being mainly the direct descendants of a very primitive human type, from which the frizzly-haired Negroes may be an offset. This character of hair must be a specialisation, for it seems very unlikely that it was the attribute of the common ancestors of the human race.

D. The fourth branch of the Negroid race consists of the diminutive round-headed people called Negritos, still found in a pure or unmixed state in the Andaman Islands, and forming a substratum of the population, though now greatly mixed with invading races, especially Malays, in the Philippines, and many of the islands of the Indo-Malayan Archipelago, and perhaps of some parts of the southern portion of the mainland of Asia. They also probably contribute to the varied population of the great island of Papua or New Guinea, where they appear to merge into the taller, longer-headed and longer-nosed Melanesians proper. They show, in a very marked manner, some of the most striking anatomical peculiarities of the Negro race, the frizzly hair, the proportions of the limbs, especially the humero-radial index, and the form of the pelvis; but they differ in many cranial and facial characters, both from the African Negroes on the one hand, and the typical Oceanic Negros, or Melanesians, on the other, and form a very distinct and well-characterised group.

II.—The principal groups that can be arranged around the Mongolian type are—

A. The Eskimo, who appear to be a branch of the typical North Asiatic Mongols, who in their wanderings northwards and eastwards across the American continent, isolated almost as perfectly as an island population would be, hemmed in on one side by the eternal Polar ice and on the other by hostile tribes of American Indians, with which they rarely, if ever, mingled, have gradually developed characters most of which are strongly-expressed modifications of those seen in their allies who still remain on the western side of Behring's Straits. Every special characteristic which distinguishes a Japanese from the average of mankind is seen in the Eskimo in an exaggerated degree, so that there can be no doubt about their being derived from the same stock. It has also been shown that these special characteristics gradually increase from west to east, and are seen in their greatest perfection in the inhabitants of Greenland; at all events, in those where no crossing with the Danes has taken place. Such scanty remains as have yet been discovered of the early inhabitants of Europe present no structural affinities to the Eskimo, although it is not unlikely that similar external conditions may have led them to adopt similar modes of life. In fact, the Eskimo are such an intensely specialized race, perhaps the most specialized of any in existence, that it is probable that they are of comparatively late origin, and were NOT as a race contemporaries with the men whose rude flint tools found in our drifts excite so much interest and speculation as to the makers, who have been sometimes, though with little evidence to justify such an assumption, reputed to be the ancestors of the present inhabitants of the northernmost parts of America.

B. The typical Mongolian races constitute the present population of Northern and Central Asia. They are not very distinctly, but still conveniently for descriptive purposes, divided into two groups, the Northern and the Southern.

a. The former, or Mongolo-Altaic group, are united by the affinities of their language. These people, from the cradle of their race in the great central plateau of Asia, have at various times poured out their hordes upon the lands lying to the west, and have penetrated almost to the heart of Europe. The Finns, the Magyars, and the Turks, are each the descendants of one of these waves of incursion, but they have for so many generations intermingled with the peoples through whom they have passed in their migrations, or have found in the countries in which they have ultimately settled, that their original physical characters have been completely modified. Even the Lapps, that diminutive tribe of nomads inhabiting the most northern parts of Europe, supposed to be of Mongolian descent, show so little of the special attributes of that branch, that it is difficult to assign them a place in it in a classification based upon physical characters. The Japanese are said by their language to be allied rather to the Northern than to the following branch of the Mongolian stock.

b. The Southern Mongolian group, divided from the former chiefly by language and habits of life, includes the greater part of the population of China, Thibet, Burmah, and Siam.

C. The next great division of Mongoloid people is the Malay, subtypical, it is true, but to which an easy transition can be traced from the most characteristic members of the type.

D. The brown Polynesians, Malayo-Polynesians, Mahoris, Sawaioris, or Kanakas, as they have been variously called, seen in their greatest purity in the Samoan, Tongan, and Eastern Polynesian Islands, are still more modified, and possess less of the characteristic Mongolian features; but still it is difficult to place them anywhere else in the system. The large infusion of the Melanesian element throughout the Pacific, must never be forgotten in accounting for the characters of the people now inhabiting the islands, an element in many respects so diametrically opposite to the Mongolian, that it would materially alter the characters, especially of the hair and beard, which has been with many authors a stumbling-block to the affiliation of the Polynesian with the Mongol stock. The mixture is physically a fine one, and in some proportions produces a combination, as seen, for instance, in the Maories of New Zealand, which in all definable characters approaches quite as near, or nearer, to the Caucasian type, than to either of the stocks from which it may be presumably derived. This resemblance has led some writers to infer a real extension of the Caucasian element at some very early period with the Pacific Islands, and to look upon their inhabitants as the product of a mingling of all three great types of men. Though this is a very plausible theory, it rests on little actual proof, as the combination of Mongolo-Malayan and Melanesian characters in different degrees to the local variations certain to arise in communities so isolated from each other and exposed to such varied conditions as the inhabitants of the Pacific Islands, would probably account for all the modifications observed among them.

E. The native population (before the changes wrought by the European conquest) of the great continent of America, excluding the Eskimo, present, considering the vast extent of the country they inhabit and the great differences of climate and other surrounding conditions, a remarkable similarity of essential characters, with much diversity of detail.

The construction of the numerous American languages, of which as many as twelve hundred have been distinguished, is said to point to unity of origin, as, though widely different in many respects, they are all, or nearly all, constructed on the same general grammatical principle—that called *polysynthesis*—which differs from that of the languages of any of the Old World nations. The mental characteristics of all the American tribes have much that is in common; and the very different stages of culture to which they had attained at the time of the conquest, as that of the Incas and Aztecs, and the hunting or fishing tribes of the north and south, which have been quoted as evidence of diversities of race, were not greater than those between different nations of Europe, as Gauls and Germans on the one hand, and Greeks and

Romans on the other, in the time of Julius Cæsar. Yet all these were Aryans, and in treating the Americans as one race it is not intended that they are more closely allied than the different Aryan people of Europe and Asia. The best argument that can be used for the unity of the American race—using the word in a broad sense—is the great difficulty of forming any natural divisions founded upon physical characters. The important character of the hair does not differ throughout the whole continent. It is always straight and lank, long and abundant on the scalp, but sparse elsewhere. The colour of the skin is practically uniform, notwithstanding the enormous differences of climate under which many members of the group exist. In the features and cranium certain special modifications prevail in different districts, but the same forms appear at widely-separated parts of the continent. I have examined skulls from Vancouver's Island, from Peru, and from Patagonia, which were almost undistinguishable from one another.

Naturalists who have admitted but four primary types of the human species, have always found a difficulty with the Americans, hesitating between placing them with the Mongolian or so-called "yellow" races, or elevating them to the rank of a primary group. Cuvier does not seem to have been able to settle this point to his own satisfaction, and leaves it an open question. Although the large majority of Americans have in the special form of the nasal bones, leading to the characteristic high bridge of the nose of the living face, in the well-developed superciliary ridge and retreating forehead, characters which distinguish them from the typical Asiatic Mongol, in so many other respects they resemble them so much that, although admitting the difficulties of the case, I am inclined to include them as aberrant members of the Mongolian type. It is, however, quite open to any one adopting the Negro, Mongolian, and Caucasian as primary divisions, also placing the Americans apart as a fourth.

Now that the high antiquity of man in America, perhaps as high as that he has in Europe, has been discovered, the puzzling problem, from which part of the Old World the people of America have sprung, has lost its significance. It is quite as likely that the people of Asia may have been derived from America as the reverse. However this may be, the population of America had been, before the time of Columbus, practically isolated from the rest of the world, except at the extreme north. Such visits as those of the early Norsemen to the coasts of Greenland, Labrador, and Nova Scotia, or the possible accidental stranding of a canoe containing survivors of a voyage across the Pacific or the Atlantic, can have had no appreciable effect upon the characteristics of the people. It is difficult, therefore, to look upon the anomalous and special characters of the American people as the effects of crossing, as was suggested in the case of the Australians, a consideration which gives more weight to the view of treating them as a distinct primary division.

III. The Caucasian, or white division, according to my view, includes the two groups called by Prof. Huxley Xanthochroi and Melanochroi, which, though differing in colour of eyes and hair, agree so closely in all other anatomical characters, as far, at all events, as has at present been demonstrated, that it seems preferable to consider them as modifications of one great type than as primary divisions of the species.

Whatever their origin, they are now intimately blended, though in different proportions, throughout the whole of the region of the earth they inhabit; and it is to the rapid extension of both branches of this race that the great changes now taking place in the ethnology of the world is mainly due.

A. The Xanthochroi, or blonde type, with fair hair, eyes, and complexion, chiefly inhabit Northern Europe—Scandinavia, Scotland, and North Germany—but, much mixed with the next group, they extend as far as Northern Africa and Affghanistan. Their mixture with Mongoloid people in North Europe has given rise to the Lapps and Finns.

B. Melanochroi, with black hair and eyes, and skin of almost all shades from white to black. They comprise the great majority of the inhabitants of Southern Europe Northern Africa, and South-west Asia, and consist mainly of the Aryan, Semitic, and Hamitic families. The Dravidians of India, and probably the Ainos of Japan, the Maoutze of China, also belong to this race, which may have contributed something to the mixed character of some tribes of Indo-China and the Polynesian Islands, and, as before said, given at least the characters of the hair to the otherwise Negroid inhabitants of Australia. In Southern India, they are probably mixed with a negrito element, and in Africa, where their habitat becomes conterminous with that of the Negroes, numerous cross races have sprung up between them all along the frontier line. The ancient Egyptians were nearly pure Melanochroi, though often showing in their features traces of their frequent intermarriage with their Ethiopian neighbours to the south. The Copts and fellahs of modern Egypt are their little-changed descendants.

In offering this scheme of classification of the human species, I have not thought it necessary to compare it in detail with the numerous systems suggested by previous anthropologists. These will all be found in the general treatises on the subject. As I have remarked before, in its broad outlines it scarcely differs from that proposed by Cuvier nearly sixty years ago, and that the result of the enormous increase of our knowledge during that time having caused such little change, is the best testimony to its being a truthful representation of the facts. Still, however, it can only be looked upon as an approximation. Whatever care be bestowed upon the arrangement of already acquired details, whatever judgment be shown in their due subordination one to another, the acquisition of new knowledge may at any time call for a complete or partial re-arrangement of our system.

W. H. FLOWER

NOTES

WE have to announce the death of Mr. Geoffrey Nevill, who died at Davos Platz on the 10th inst. He was for many years Assistant Superintendent in the Calcutta Museum, and had charge there of two conchological collections, which were entirely arranged and named by him. He did some good work there.

IN a recent issue we gave some account of the Liverpool Corporation free lectures, which were then in the experimental stage. Since then the lectures have been continued every winter, and we should like to call the attention to them of those of our readers who are interested in the promotion of elementary scientific knowledge among the lower classes, and especially those who have, either as town-councillors or magistrates in their respective towns, influence in their own localities. We have before us a programme of the present course, copies of which can be obtained from Mr. P. Cowell, Liverpool Free Public Library. The lectures are given every Monday, Tuesday, Wednesday, and Thursday from January 5 to March 12 inclusive, in the Rotunda Lecture Hall of the Library, which holds more than 1500 people. The entire expense of them is defrayed by the Corporation, and admission is perfectly free. A member of the Corporation invariably occupies the chair at each lecture. Mr. Lant Carpenter lectured there on the night of February 12 upon "Sunspots and their Connection with Weather Changes," to an audience of great extent. It was composed almost exclusively of "the great unwashed," who had come in straight from their work, or, alas, in some cases, from their inforced idleness; the Liverpool dock porters were there in

their hundreds! The audience, though larger than usual, was not exceptionally so. Notwithstanding the somewhat technical and abstruse nature of the subject, involving an explanation of the application of the principles of spectrum analysis to solar physics (in which the oxyhydrogen lantern illustrations were, during half the lecture, a great assistance), this large audience of *unskilled labourers*, men and youths, listened for nearly an hour and a half with the closest attention, strongly resenting the solitary attempt at interruption, and at the close of the lecture were most enthusiastic in their approval. Why cannot the same thing be done in other large towns, and must we wait for London municipal reform to get it done in the metropolis?

IN *La Nature* of February 14, under the title of "The Struggle for Existence," is a curious account of an attack on a dog by a flock of crows. The account of the affray is given by M. Magin, director of St. Albert Glassworks, Anecht, Nord. M. Magin states that in January last, when the ground was covered with snow, his dog (a *Griffon*) was in a field adjoining the workshop, when he was attacked by a flock of crows. About a hundred were in the field, but only about thirty actually joined. Dividing themselves into two parties, one attacked the poor dog before, and another behind. Rising about two metres above ground, they would plunge their beaks invariably into a bleeding wound. When the dog was rescued by the workmen he was in a dilapidated state, his eye torn out, and a deep wound in the neck. The crows remained about the place for some time after the rescue of the dog.

THE Statistical Society proposes to celebrate the jubilee of its foundation on June 22 and 23 next. It is proposed to invite to the celebration distinguished statisticians from foreign countries, several of whom, it is hoped, will be Government representatives.

THE Mersey tunnel was opened on the 13th inst.; it was begun in the end of 1879. It may be stated that the length of the projected railway is two miles and a half, from James Street, Liverpool, to Green Lane, Tranmere; and from shaft to shaft the distance immediately beneath the River Mersey is about one mile. For the two stations in James Street, Liverpool, and Hamilton Square, Birkenhead, the necessary excavations were some time ago completed.

FOR the first time, we believe, in English warfare, balloons are to be utilised in the Soudan Campaign. The transport *Queen* sailed on Monday from the Thames with the Balloon and Telegraph Corps for the Suakin Expeditionary Force. Three balloons are taken out with all the necessary appliances to be used for taking observations of the enemy's positions. All have been made at the School of Engineering. Compressed hydrogen for inflating the balloons is carried in iron cylinders, 12 feet long by 1 foot diameter, but these are only for a reserve supply, and, weighing half a ton each, will be left behind at the base of operations, where, also, a gas factory and pumping station will be put up. Materials for this purpose are on board the ship, including a small gas-holder, and all the necessary chemicals for making more gas are provided. About a hundred lighter cylinders, easily carried by men, form part of the equipment. Each of these, which are 9 feet long, contains 120 feet of hydrogen in a compressed state, and, as they are emptied, they will be taken back to be recharged at the Suakin station. One waggon, containing one ton of stores, will suffice for a balloon ascent. Captive ascents only will be made, in which the balloons will be tethered by rope or wire, both of which are taken. Communication by telephone will be established between the car and the ground, and the chief employment of the balloons will be to take observations of the enemy's movements.

A MEETING, called together with the object of obtaining a more extended support for the Parkes Museum, was held at the Mansion House on Friday, the Lord Mayor (Mr. Alderman Nottage) presiding. The Lord Mayor, in opening the proceedings, said the object of the organisers of the Parkes Museum was to promote the physical welfare and happiness of, he might say, the human race. Capt. Douglas Galton read a statement on behalf of the joint committee of members and council, from which it appeared that the museum was founded at a meeting presided over by Sir William Jenner in July, 1876, in memory of the late Edmund Alexander Parkes, who was the first Professor of Hygiene in this country. The Queen and other members of the Royal Family had subscribed to the funds, and had taken great interest in the Institution. Out of it had arisen the International Medical and Sanitary Exhibition, and the Health Exhibition. The Museum is open free for a part of every day in the week. The lectures have been given for the benefit of the Working Men's Club and Institute Union, the Institution of Builders' Foremen and Clerks of Works, and the Metropolitan Building Societies. The Museum has also been placed at the disposal of teachers of hygiene, and classes have attended from University College, St. Bartholomew's Hospital, Guy's Hospital, the Royal Engineers, and the Young Men's Christian Association. The reading-room, with its valuable library of sanitary literature, has always been a distinguished feature of the Museum, and has recently been enhanced by the addition of 1500 volumes contributed by the Council of the International Health Exhibition. For upwards of eighty years the Museum has been maintained by voluntary contributions. To keep it open to the public it has become necessary that at least 1000*l.* should be raised by the end of the present month. The Duke of Cambridge moved "That the statement which has been read affords conclusive evidence that the Parkes Museum of Hygiene is meeting a great educational want, and is worthy of increased support." There were two chief considerations which presented themselves to his mind—the first was, that the Society must get out of the difficulties it was in; and next, the Museum must be established on a sure footing, so as to enable its advantages to be extended. The premises at present occupied by the Society must be re-engaged, and it would be necessary to widen its utility in coming years. Mr. Ernest Hart said he thought the wealthy and practical City of London could not be proud of its attitude towards this valuable Institution. Nearly all the supporters of the Museum came from the West-end, and were largely from among the professional and medical classes. The importance of the Museum might be gathered from an outside indication—namely, that the idea had been imitated, and the example extended in the United States, in France, in Italy, and Japan. He thought they were entitled to support, not only from the great merchants and bankers of the City, but from the Corporation and the City Companies. The Parkes Museum was a mere skeleton sanitary museum. It was without a laboratory, without lectures, without demonstrators. In other countries the State subsidised their Health Museums, and that it was deserving of the highest recognition from a merely commercial point of view had been conclusively shown by Sir James Paget's statistics as to the pecuniary national loss from preventible disease. A list of subscriptions amounting to 1006*l.* was announced.

THE death is announced of Mr. Holder M. Westropp, the well-known archæologist, at the age of sixty-four years.

PROF. JOHN MARSHALL on Saturday, in the theatre of the Royal College of Surgeons, delivered the annual Hunterian oration before a distinguished medical audience. The orator considered the mental attitude which "the Founder of Scientific Surgery" would probably assume towards the active work and salient opinions of our times. The revelations of microscopical research and the growth of a new department of anatomy, histology, would have delighted Hunter, and his acquiescence in the truth of a modified cell-theory of the formation of tissues, and in

the doctrine of the protoplasmic origin of animal and vegetable life, could be easily imagined. Not only as a physiologist, but as a pathologist, Hunter was a great vivisector, and it might be taken for granted that he would rank himself with those who now claim the right of man, for beneficial purposes, or even in the pursuit of knowledge, to attempt to discover the processes of animal life by tests and trials on living animals. While averse to unnecessary repeated experiments, his large views of the unity of the "principle of life" and of the community of organisation and of action throughout the whole animal kingdom would lead him to disregard the objections of those who insist on the uselessness of experiments on animals so far as concerns their application to man. Hunter did not spare his own body, but subjected himself to an inoculation experiment of a very grave character, in order to test opinions on a pathological question, and to put to proof the efficacy of certain variations in treatment. Since his time the inquiry as to the functions of the nerves and the nerve centres had made great strides, almost exclusively by means of experiments. Had Hunter lived now he would have been a staunch evolutionist, his belief being that "from the variations produced by culture it would appear that the animal is so susceptible of impression as to vary Nature's actions, and this is even carried into propagation." Hunter expressed the opinion that in time it might perhaps happen the human race should be exterminated by specific poison diseases; but he regarded it as more probable that many poisons were extirpated, and that new ones might arise in their stead every day.

THE National Fish Culture Association are about to establish a Museum of British and Foreign Fishes, and a large number of valuable specimens have already been presented for preservation. The project has met with unmistakable signs of approbation, and is likely to receive the hearty co-operation of the ichthyological world. The latest addition to the collection is an exceedingly fine specimen of a trout weighing 23 lbs.

IN an address at the last meeting of the Society of Meteorology of France, M. Hervé-Mangon described the growth of meteorological science in that country. It is curious, he said, that in the first part of this century, meteorology had fallen into strange discredit with the most distinguished men of science, one of whom called it "the poor science." The Hydrometric Society of Lyons, founded in 1840, was the only one in France occupying itself with atmospheric phenomena; the *Meteorological Annual* was not founded till 1849, and the Society of Meteorology till 1853. In 1855 Leverrier created the system of telegraphic warnings. In 1878 the Society succeeded in getting the Government to reorganise the system of telegraph weather reports, and to create a central meteorological bureau, while numerous observatories had been erected all over the country, and Paris was now in connection with 1500 stations. In 1852 France participated in the International Congress of Meteorology at Brussels, but for twenty-six years after that they took part in no similar reunion. But, owing to M. Hervé-Mangon's exertions, the Congress of 1878 was invited to be held in Paris, and in 1879 France took formal part in the Congress at Rome.

M. HANSEN-BLANGSTED, of Paris, has recently published, under the title of "Un Progrès," an account of the manner in which the metric system of weights and measures is extending over Europe. Confining himself to Germany, Austro-Hungary, and Norway since 1870, he points out that in German geography down to 1869 all the measures were given in the system of the country. In 1865 *Petermann's Mittheilungen* expressed geographical measures of length, height, depth, and superficial area in German or English measures. In 1869 French measures were employed, that is, they were put side by side with the English and German. Since 1875 the metric system is almost exclusively employed, and it is always added where a writer does not use it. Prior to 1870 the metric system was rarely employed in the *Geographische Jahrbuch*, in 1876 it had made much progress, and now it is almost the only one in use. Dr. Daniel's large geography in four volumes, the fifth edition of which was published by Dr. Delisch in 1882, is used everywhere throughout Germany, and is an undoubted authority. Here all the geographical measures are given according to the metric system; the German system is not used even in parenthesis. In Austria we find that Dr. Umlauft uses the metric system exclusively in his "Rundschau für Geographie und Statistik." In "Das eiserne Jahrhundert" also the same is the rule. Dr. Umlauft has lately published a work devoted wholly to the geography of the Austrian empire, which is widely spread and used in schools. He employs in it only the metrical system. In Norway, the geographical works of the former Minister, M. Broch, both in Norwegian and French, have had much effect in propagating the knowledge and employment of the metric system, for he uses the latter side by side with the Norwegian measures. For the first time in the geography of P. Geelmuyden, published at Christiania in 1882, the metric system is exclusively adopted, the Norwegian measures being placed in parentheses. This work forms one of the text-books for primary and advanced instruction in the schools.

M. NIKITINSKY has recently made a series of experiments for determining whether the amount of ash given by burnt tea-leaves really increases with the decrease of the quality of tea, as was asserted a few years ago. Taking different kinds of tea, the price of which was respectively 72, 64, 34, 12·8, and 12·12 Chinese *lans*, he found that they gave respectively the following percentage of ash: 5·16, 5·21, 5·66, 5·91, and 6·32. The difference is thus very small. A cheap green "brick-tea" gave a percentage of 6·87. The Orenburg teas, which are sold under the name of Buray-tea, at the price of 12 and 5 roubles for 16 kilogrammes, and are adulterated with leaves of *Epilobium angustifolium*, gave a far greater quantity of ash, namely, 7·87 and 10·43 per cent., thus affording a means for discovering this kind of adulteration.

THE Report of the Botanical Record Club for 1883 is just published. For those interested in the details of the geographical distribution of British plants, these annual publications form an indispensable supplement to the posthumous edition of H. C. Watson's "Topographical Botany," published in 1883.

PROF. STRICKER'S work, "Studien über die Sprachvorstellungen," has now been translated into French by F. Schwiedland. This French edition, which has been enlarged by some new chapters by the author himself, is published by Félix Alcan at Paris.

OLDENBOURG of Munich has just published "Die Hieracien Mittel-Europas. Monographische Bearbeitung der Piloselloiden mit besonderer Berücksichtigung der mitteleuropäischen Sippen," by C. von Nägeli and A. Peter.

AN officer of the French Staff has gone to Algiers and Tunis in order to continue the work of the late Col. Roudaire. But it is not likely that he will succeed, although he is strongly supported by M. de Lesseps. In the colony the opinion is strongly against the scheme. The argument of its opponents is the insalubrity which would result from the presence of these salt waters in an extremely hot country without any appreciable current, and frequent changes of level owing to evaporation.

WE understand that the *Quarterly Journal of Microscopy and Natural Science* will in future be published by Messrs. Baillière, Tindall, and Cox.

MR. A. S. OLIFF and Mr. J. D. Ogilby have been appointed assistants in the Australian Museum.

SHOCKS of earthquake continue to be felt in the south of Spain. A telegram from Granada on the 12th stated that slight shocks continued to be felt at Alhama, and on that day there was a shock at Terre del Campo near Jaen. There were also shocks in the evening of the 14th at Granada and Velez Malaga.

Die Natur takes advantage of the attention at present directed to South Africa, to recall the story of the first astronomical expedition to the Cape. The first expedition ever sent across the seas for such a purpose as astronomical observation was that of Jean Richer, which went to Cayenne on behalf of the Paris Academy, in order that simultaneous observations of Mars should be made there and in Paris. The Cape expedition took place thirty years later. Baron Krosigk, its promoter, had founded a private observatory at Berlin, where observations of the moon's culminations were made for a long period, and observers were sent to the Cape to make corresponding observations there. It was hoped that by collating the observations in both places the moon's parallax would be obtained. So far as this was concerned, the expedition failed. Wagner, the founder and first head of the public observatory at Berlin, carried out his part of the work in Prussia, but Kolb, who had charge of the Cape expedition, was guilty of great negligence, so that the results were inconsistent and unsatisfactory. In 1719 he published a book entitled "Caput bonæ spei hodiernum," in which he described everything at the Cape except what he was sent to do. The work which Krosigk hoped to do then was not completed for another forty years, when Lacaille and Lalande made the necessary observations, the one at the Cape, the other in Paris.

MR. CARL ARMBRUSTER will begin a course of five lectures at the Royal Institution on "The Life, Theory, and Works of Richard Wagner," on Saturday, February 28 (with vocal and instrumental illustrations).

IN order to ascertain the truth of the assertions recently made by certain ichthyologists in regard to the capacity of Canadian salmon to exist in sea water, an experiment has been made in the South Kensington Aquarium, several specimens being deposited in one of the salt-water tanks, where they lived for eight days, when they expired in rapid succession. This entirely dissipates the theory which obtained credence hitherto in numerous quarters.

THE additions to the Zoological Society's Gardens during the past week include two Laughing Kingfishers (*Dacelo gigantea*) from Australia, two Hooded Crows (*Corvus corax*) from Connemara, Ireland, presented by Lady Brassey, F.Z.S.; a Sharp-nosed Crocodile (*Crocodilus acutus*) from Nicaragua, presented by Mr. C. G. Brown, M.R.C.S.; a Common Boa (*Boa constrictor*) from South America, deposited; a Cook's Phalanger (*Phalangista cooki* ♀) from Australia, a Globose Curassow (*Crax globicera*) from Central America, two Stanley Parrakeets (*Platycercus icterotis jv.*) from Western Australia, purchased; two Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

AN ANCIENT OCCULTATION OF JUPITER.—In Roger de Hoveden's Chronicle, under the year 756, we read:—"Eodem anno Balthere anachorita vitam sanctorum secutus est, et migravit ad Dominum; Luna autem sanguineo rubore superducta octavo Kalendas Decembris quindecima ætate, id est plena, sicque paulatim decrescentibus tenebris ad lucem pristinam pervenit; nam, mirabiliter, ipsam lunam sequente lucida stella et pertranseunte tanto spatio eam antecedebat illuminatam, quanto sequebatur, antequam esset obscurata." (*Chronica Magistri Rogeri de Hovedene*, edited by William Stubbs, M.A., vol. i. p. 7.) Simeon of Durham records the phenomenon in similar terms, and also dates it in A.D. 756; but this has been long known to be a mistake, the eclipse of the moon, to which reference is made, having taken place on the evening of November 23, A.D. 755.

Calvisius at first supposed that the star which was occulted by the moon at the time of this eclipse might have been the "Oculus Tauri" or Aldebaran, and submitted the point to computation, though, as Pingré remarks, this was unnecessary, as a star with a latitude of more than 5° could not be occulted by an eclipsed moon. Struyck, in the first edition of his well-known geographical and astronomical treatise, published in 1740, stated that, on calculating the place of the moon, he had found there was no bright star near her at the time, and it occurred to him that perhaps the planet Jupiter might have been occulted by the eclipsed moon, which, on applying "Whiston's Tables," he ascertained to have been actually the case: the tables referred to were those of Halley in their early form. Struyck found the time of the planet's disappearance 6h. 30m. at London, and that of the reappearance 6h. 57m. (see Zach's *Monatliche Correspondenz*, i. 576).

The following results will probably supply a much closer approximation to the actual circumstances of the phenomenon recorded by the English historians.

For the elements of the eclipse of the moon we have—

G.M.T. of opposition in R.A., 755, November 23, 6h. 25m. 7s.

R.A.	63°	3′	15″
Moon's hourly motion in R.A.		30	54
Sun's ,, ,,		2	41
Moon's declination	21	4	20 N.
Sun's ,,	21	16	37 S.
Moon's hourly motion in declination		8	8 N.
Sun's ,, ,,		0	28 S.
Moon's horizontal parallax		54	16
Sun's ,, ,,		0	9
Moon's true semi-diameter		14	47
Sun's ,, ,,		16	16

The sidereal time at Greenwich noon was 16h. 7m. 34s. The moon was full at 6h. 30m.

From the above elements we find—

		h.	m.
First contact with the shadow	Nov. 23,	4	38
Beginning of total phase	,,	5	47
End of total phase	,,	7	18
Last contact with the shadow	,,	8	27

Employing Bouvard's Tables of Jupiter the following are the positions of the planet:—

Paris M.T. h.	Apparent R.A. ° ′ ″	Apparent decl. ° ′ ″
7	64 23 25	20 50 12 N.
8	64 23 3	20 50 9 N.

The log. distance of Jupiter from the earth was 0·6163.

Calculating the circumstances of the occultation for London, we find with the above data that the disappearance would take place at 7h. 35m., and the reappearance at 8h. 33m.; the former would therefore occur while the moon was still partially eclipsed, and the latter a few minutes after she emerged from the earth's shadow.

It may be mentioned that the moon's place has been determined in the same manner as for the occultation of Mars observed by the Chinese at Siganfou B.C. 69, February 14, and that of Venus, A.D. 361, March 20, at Nankin, the phenomena being well represented in both cases, as previously detailed in this column. No doubt the introduction of Leverrier's Tables of Jupiter would somewhat modify the times of disappearance and reappearance on November 23, 755, here given; our object has been merely to confirm Struyck's explanation of the recorded phenomenon.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, FEBRUARY 22–28

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on February 22

Sun rises, 7h. 1m.; souths, 12h. 13m. 39·6s.; sets, 17h. 26m.; decl. on meridian, 10° 1′ S.: Sidereal Time at Sunset, 3h. 37m.

Moon (at First Quarter at 11h.) rises, 10h. 37m. ; souths, 18h. 19m. ; sets, 2h. 8m.* ; decl. on meridian, 17° 8′ N.

Planet	Rises	Souths	Sets	Decl. on Meridian
	h. m.	h. m.	h. m.	° ′
Mercury ...	6 44 ...	11 18 ...	15 52 ...	17 4 S.
Venus ...	6 30 ...	11 5 ...	15 40 ...	16 54 S.
Mars ...	7 3 ...	12 6 ...	17 9 ...	11 52 S.
Jupiter ...	16 56* ...	0 4 ...	7 12 ...	12 28 N.
Saturn ...	10 50 ...	18 54 ...	2 28* ...	21 36 N.

* Indicates that the rising is that of the preceding, and the setting that of the following nominal day.

Occultations of Stars by the Moon

Feb.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
22 ...	Aldebaran ...	1 ...	17 17 ...	17 50 ...	20 336
23 ...	130 Tauri ...	6 ...	23 3 ...	0 2†...	145 288
26 ...	B.A.C. 2872 ...	6 ...	15 59 ...	16 24 ...	340 286
27 ...	α Cancri	4 ...	4 1 ...	4 53 ...	104 303
28 ...	B.A.C. 3407 ...	6 ...	5 24 ...	5 37 ...	187 216
28 ...	π Leonis	5 ...	6 5 ...	6 45 ...	147 253
28 ...	35 Sextantis ...	6 ...	23 59 ...	1 4†...	38 287

† Occurs on the following day.

It may be mentioned that times of disappearance and reappearance for the occultation of Aldebaran for various other positions in the United Kingdom will be found in NATURE, vol. xxxi. p. 322.

Phenomena of Jupiter's Satellites

Feb.	h. m.		Feb.	h. m.	
23 ...	22 49	III. occ. disap.	27 ...	1 51	II. tr. ing.
24 ...	2 49	III. ecl. reap.		4 47	II. tr. egr.
	5 24	I. tr. ing.		18 16	I. tr. ing.
25 ...	2 32	I. occ. disap.		20 35	I. tr. egr.
	4 57	I. ecl. reap.		21 38	IV. tr. ing.
	23 50	I. tr. ing.	28 ..	2 11	IV. tr. egr.
26 ...	2 9	I. tr. egr.		17 54	I. ecl. reap.
	20 58	I. occ. disap.		20 48	II. occ. disap.
	23 26	I. ecl. reap.			

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Feb.	h.	
23 ...	8 ...	Saturn in conjunction with and 3° 44′ north of the Moon.
28 ...	12 ...	Jupiter in conjunction with and 4° 27′ north of the Moon.
28 ...	18 ...	Mars at least distance from the Sun.

GEOGRAPHICAL NOTES

GEN. GORDON, when Governor of the Soudan in 1874, sent home to a friend a map of the route between Suakim, Berber, and Khartoum, drawn by himself. Mr. Stanford has reproduced this map in facsimile by permission, and it will probably be of great interest at the present juncture.

MR. STANFORD has recently issued two maps of the Soudan, in connection with the military operations which are at present being carried on in that region. These maps are most excellent, and must prove highly serviceable to all who wish to follow the course of events.

A VOLUME on New Guinea, which should be of great interest, is about to appear in Holland. The former Dutch Resident at Ternate, Mr. van Braam-Morris, in the course of his official tours on the Amberno or Rochussen rivers, succeeded in going a considerable distance to the south. His report, with the accompanying map, is now being prepared for publication by Mr. Robidée van der Aa, who is himself a high authority on New Guinea.

MR. A. M. SKINNER, Vice-President of the Straits branch of the Royal Asiatic Society, has published at Singapore, a Geography of the Malay Peninsula and the surrounding countries, in three parts, containing almost all that is known regarding the physical and political geography of these regions. The idea of the work was suggested by the Council of the Royal Colonial Institute, applying to the various Colonial Governments for school-books which might be used in schools at home for the instruction of pupils in the position, resources, and general progress of the Colonies.

IT is announced that Mr. Stanley's new work on "The Congo" will be published by Messrs. Sampson Low and Co. in April next.

UNDER the title of *O Explorador* (the Explorer) a Portuguese journal commenced its appearance with the new year at Lisbon. It will appear twice a month, and will chronicle the advance of science in all its branches, but especially that of geography and travel.

AT the meeting of the Geographical Society of Paris on the 6th inst. a letter was read from the French consul at Zanzibar describing recent events of geographical interest in Eastern Africa. Lieut. Gouin, Resident of France at Nam-Dinh, in the delta of the Red River, gave some information on the navigation and commercial resources of the southern mouths of the Red River. The most southern of all, the Cua-Day, is said to be navigable for sea-going junks, and to give immediate access to the richest rice-producing provinces of the delta. M. Léon Rousset read an account of a journey of eight months in Turkey. He dealt chiefly with the junction of the Turkish with the European railways.

ON A MODIFICATION OF FOUCAULT'S AND AHRENS'S POLARISING PRISMS

IN tracing by the usual methods the course of rays through one of the polarising prisms recently devised and constructed by Mr. C. D. Ahrens (described in the *Journal* of the Royal Microscopical Society for September 1884, and in the *Philosophical Magazine* for last month), I found that, in the case of a ray incident in a direction parallel to the axis of the prism, that component of it which passes through the middle spar-prism as the ordinary ray falls on the second surface of that prism at an angle of 42° 35′.

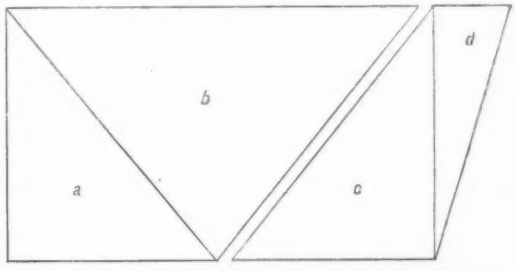
This is greater than the critical angle (37° 12′) for ordinary rays passing from calc-spar into air. Hence, if a film of air (as in Foucault's prism), instead of a film of Canada balsam (as in Ahrens's prism), is placed between this spar-prism and the next, the ordinary ray will be totally reflected, while the extraordinary component will still emerge and be available as a plane-polarised ray for experiments, as in Foucault's prism.

This extraordinary ray, however, is not only deviated on emergence, but also over-corrected for colour ; the deviation from the direction of the original incident ray being—

For Fraunhofer's line F ... ... 12° 20′
,, ,, C ... .. 12° 35′

(as determined by using the light of a hydrogen vacuum-tube).

Both the deviation and the dispersion can be almost entirely corrected by passing the ray through a prism of crown glass combined with a prism of very dense flint glass, as shown in the drawing given below.



a, calc-spar ; *b*, calc-spar ; *c*, crown glass ; *d*, dense flint glass.

What is said above respecting the ray incident parallel to the prism-axis applies to all rays incident at angles not greater than 14° with the axis ; and thus the combination forms a polarising prism with an angular field of 28°, about equal to that of an ordinary Nicol's prism, and far greater than that of a Foucault's prism (which is only 8°).

The following points, among others, appear noteworthy in the above prism :—

(1) Its length is scarcely more than twice its breadth, the proportion between the two dimensions being rather greater than in

Foucault's prism, about the same as in Ahrens's prism, and much less than in Nicol's prism.

(2) Only half the prism is made of Iceland spar, a material which is becoming deplorably scarce and expensive (I question if there is in England or elsewhere a piece of spar fit to make a Nicol's prism of 5 cm. aperture). The saving, however, is not so great as it appears, since the spar-prisms *a* and *b* are constructed on Wollaston's principle, and involve a certain waste of material.

(3) The combination is not quite free from distortion and chromatic aberration (the latter being due, of course, to irrationality of dispersion; it is practically impossible to achromatise spar with glass), but the imperfection is not serious enough to interfere with its use for many optical purposes, especially as a polariser.

(4) In using it, a diaphragm should be placed in such a position as to limit the entering cone of rays to 28°, since at a greater angle (at any rate, on one side of the field) the ordinary rays are not separated by total reflexion.

Doubtless the prism may be improved upon by better authorities than myself; but I think that the principle of using a "double-image" prism to increase the divergence of the ordinary and extraordinary rays before one of them is separated by total reflexion is worth attention.

Ahrens's polarising prism is certainly a remarkable one. I do not think that a double-image prism has ever been previously constructed in which the extraordinary ray emerges without deviation, while the other ray is deviated to the extent of very nearly 60°.

H. G. MADAN

Eton College, February 17

THE RESULTS OF THE SCIENTIFIC EXPEDITION TO SODANKYLÄ

THE Government of Finland having provided further funds, the Expedition has continued its researches at Sodankylä, in Finnish Lapland, during the year 1883-84 (NATURE, vol. xxvii. pp. 322 and 389). The plan of working this year was chiefly confined to the study of the terrestrial galvanic currents, atmospheric electric currents, and the phenomena of light produced by the apparatus constructed by me for the purpose. The number of daily meteorological and magnetic observations was restricted to three, viz. at 6 a.m., 2 and 10 o'clock p.m., Göttingen mean time, but on the 1st and 15th of each month observations were taken every five minutes, as in the previous year, and on the 8th and 22nd of each month, from 8.30 p.m. till 10.30 p.m., observations were taken every half minute.

The general meteorological and magnetic observations were continued without interruption until August 22, 1884. In the account of the observations on the luminous phenomena will be included a *résumé* of the general character of the weather of this year.

The Terrestrial Current.—From the middle of September 1882 the Expedition has observed the terrestrial currents, as well as the magnetic variations. For this purpose two circuits about 5 km. long were placed north-south and east-west. They were connected to platina plates 1 decimetre square, and buried about 1·3 m. below the surface of the ground. The southern and eastern plates were about 0·5 km. from the station. During this year the observations were confined chiefly to the variations of the terrestrial current, hence no attempt was made to separate the electromotive force of the terrestrial current from that which was developed by the contact of the plates with the earth.

In the autumn of 1883 it became necessary to place fresh wires in the circuits, and at the same time the position of the plates was changed, so that each one was now about 2·5 km. from the station. The old circuit lying east and west was, however, left undisturbed for some time for the purpose of making comparisons.

It was not until the middle of January that observations of the terrestrial currents were commenced at the auxiliary station at Kultala, 68° 29′·5 N. (see Fig. 1). Here the circuits for the terrestrial current were placed so that the one lying north-south, 2·9814 km. long, was 3° west, and the east-west circuit, 4·5663 km. long, lay 69° north-west. This arrangement was made to permit the plates of the east and west being placed in the River Ivalo, and those lying north-south, in two affluents of this river. At this station attempts were made to eliminate that portion of the electromotive force which arose from the contact of the plates with "earth" (here the water) as well as the polarisation. The method employed was as follows:—With a Mascart electrometer, the sensitiveness of which had been exactly measured by a "Daniell" normal element (about 18 divisions of the scale per volt), the electromotive force of all the four plates in the earth was determined. These were then joined in six different ways with a galvanometer, and the deviations noted. A Daniell normal element, furnished with an adjustable resistance-slide, was then placed in the circuit in a contrary direction to the current, and the electromotive force was then reduced till the deviation was = 0. Thus the electromotive force of the different plates was obtained free of polarisation by means of an electrometer.

To eliminate the electromotive force arising from the contact

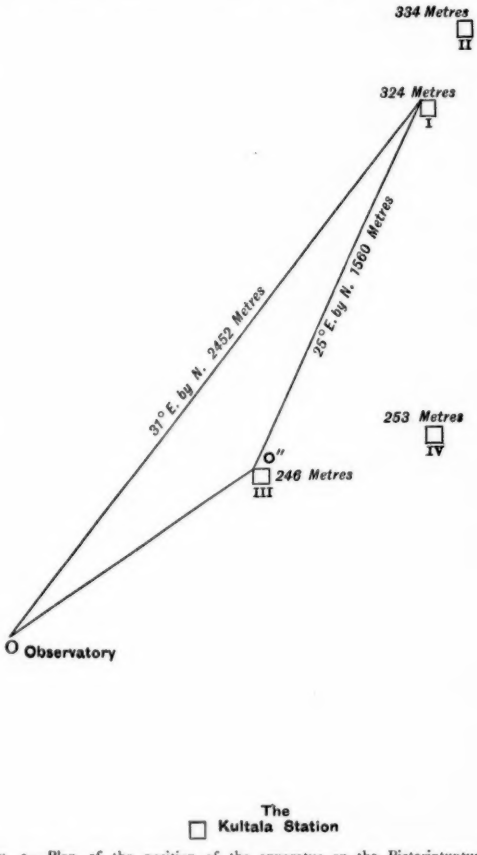


FIG. 1.—Plan of the position of the apparatus on the Pietarintunturi Mountains.

of the plates with the water, the latter were taken to the station and sunk in the river close by. They were connected with a wire from the circuits resting on Mascart insulators. Their electromotive force was examined by means of an electrometer, which was discharged each time by a plate of zinc amalgam sunk in the river. This experiment was also made in another manner. All the plates were sunk in a bucket of water resting on Mascart insulators and connected with the earth by a copper wire. The two latter experiments gave very similar results. When the platina plates had been examined in this manner, they were placed in their former positions, after which they were again examined both by the galvanometer and electrometer. The details of this experiment, as well as those of others, must, however, be reserved for a special memoir. By the above-mentioned means results are shown free from any accidental disturbing influences. Some observations, though as

yet they have not been finally worked out, gave the following results :—

(1) When two galvanometers, as nearly equal as possible, were introduced into the two circuits lying east–west near Sodankylä, and which, as we have said, were moved towards each other so that the old circuit was 2·5 km. further east, the variations of the two galvanometers were *nearly identical*. This appears clearly from the graphic account of the deviations as they were observed on Oct. 16 from 5h. 25m. to 5h. 55m. p.m. (see Fig. 2). In the abscissa each centimetre represents two minutes, and in the ordinate each millimetre represents a deviation of 20 divisions of the scale, equal to an arc of 20′. The plates of the circuits in question having been sunk to a depth of 1·3 m., it is clear that the variations observed arose from changes in the electromotive force of the terrestrial current, and could not have their origin in the changes in the electromotive force arising from the contact of the plates with the earth, for had the latter been the case, the variations could scarcely have shown such extraordinary coincidence. Other similar experiments show, however, that small inaccuracies may occur.

The two curves do not correspond exactly in the intensity of the variations, which arises from the fact that the resistance of the old circuit was greater than that of the new.

While the variations which were greater and more numerous in an east–west direction occurred nearly always at Sodankylä, so that the needles of the galvanometer at that place were rarely at rest, the contrary was the case at Kultala, that is to say, the occasions on which the needles of the galvanometer were in motion were very rare.

As these facts were already observed by me in 1871 and 1882,

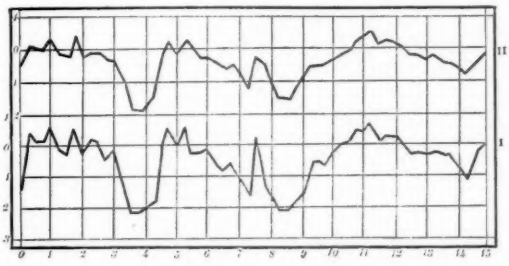


FIG. 2.—Curve I. shows the deviations of the galvanometer in the old conductor. Curve II. shows the deviations of the galvanometer in the new conductor. Each centimetre of the abscissa indicates 2 minutes. The observations were made every half minute. Each millimetre of the abscissa indicates 20′ of the scale = 20′ of an arc.

it seems fair to assume *that the North Pole of the earth is surrounded by a belt in which the terrestrial currents are stronger and more variable than they are north and south of this belt.*

The northern limit of this belt seems to be about 68° N. The position of this belt of terrestrial currents depends probably upon the belt of the aurora borealis.

(3) The magnetic variations and the changes which govern the terrestrial currents follow each other closely. We know that the former depend very much upon the aurora borealis, and that this dependence also influences the latter. However, the laws of this dependence cannot be determined until the materials of the observations have been fully analysed.

The Electric Currents of the Atmosphere studied by means of the Discharging-Apparatus.—Since Franklin and Dalibard proved—about the middle of the last century—by practical experiments that lightning is an electric phenomenon, many attempts have been made to measure the electricity which is always present in the atmosphere. These experiments have become more general since the discovery by Lemonnier, a Frenchman, that electricity was present in the air even without thunderstorms. Numerous methods have been invented and employed for examining this electricity, while all had for their object the measurement of the electricity present in a given spot at a given moment. In this manner the atmospheric electricity was carefully observed and registered, and by means of these records it was hoped to arrive at some definite conclusions. Sometimes researches were made to determine the variations of tensions in different directions, particularly the vertical direction. As a general result, but not without exception, these experiments showed *that the electrical tension* (or potential) *increased with the distance from the earth's surface.*

The knowledge of the electric charge, or the quantity of electricity present in a given atmospheric space, does not yet convey an exact idea of the electric phenomena which take place therein, but the knowledge of the variations accompanying it in different directions enable us to ascertain the *movements of the electricity*, or, in other words, *the electric currents of the atmosphere.* When we know by experience that the generality of effects, and the most important, which produce electricity arise from *electric currents*, it will easily be understood that the examination of the atmospheric electricity should have for its principal object the visible demonstration of these currents, and an explanation of the laws which regulate them.

The reason why the question has not as yet been studied from this point of view is probably that the air has been regarded as an insulating medium in which only momentary *electric discharges* occur, and not *electric currents.*

In the aurora borealis we have a "brilliant" proof of the existence of these currents, but up to the present the cause has always been sought elsewhere.

It is of course understood that a great number of *savants* have long been of the opinion that the aurora borealis was of electric origin. Having obtained, while with the Swedish Polar Expedition of 1868, some experience of electric phenomena in Arctic regions, I made some attempts during the expedition of 1871, near the church of Enare, to see if it was possible with the few means at my disposal to examine this supposed electric current (NATURE, vol. xxvii. pp. 322 and 389). I then succeeded, by means of a small discharging-apparatus, in demonstrating the presence of this current and in producing luminous phenomena, but, owing to certain external difficulties which I could not overcome at that time, these results are uncertain. During the year 1882–83 the Expedition at Sodankylä had occasion to make some similar but more extensive experiments, which were crowned with success, as I have previously stated in this journal (vol. xxvii. pp. 322 and 389). An electric current from the air towards the earth was proved to exist. Close to the village of Sodankylä we produced, by means of a large "discharging apparatus" or network of pointed conductors erected upon the summit of Orantunturi (1000 feet in height) a diffuse yellowish light, which, in the spectroscope, showed the ordinary auroral spectrum ; and later on a veritable ray of the aurora borealis was produced on the Pietarintunturi Mountain, close to Kultala. On both occasions the electric current was measured.

Important as were the results of these experiments, they were, however, only of a provisional character, because, in carrying them out, difficulties of every description had to be overcome. In all these experiments the apparatus was connected with the earth by a wire leading to a zinc plate immersed in a well. Owing to the contact of the zinc with the water, an electromotive force was produced, and it was therefore probable that the current observed by the galvanometer might have its principal, or perhaps sole, origin in this electromotive force.

The expedition of 1883–84 was supplied with instruments for overcoming these difficulties as well as others, and has examined as closely as possible the laws which this current obeys.

After the arrival of the expedition at Sodankylä about the middle of September, a provisional apparatus was constructed on the mountain Komattivaara, lying 6 km. from the station, and about 437·5 feet = 129·7 m. high.

A conducting wire, supported by Mascart insulators, was placed from the apparatus on the mountain to the station, where it was joined to a galvanometer, which was connected with the earth by a plate of zinc (amalgam) placed in the neighbouring river. After some preliminary trials with this apparatus, which showed that, in spite of the lowness of the mountain, the atmospheric current could be examined, a "discharging apparatus," or network of pointed conductors, was erected upon a solid wooden structure, and was ready by October 19. The apparatus consisted of iron wires with welded points 0·5 m. apart. The wire was arranged in a series of squares 1·5 m. from each other, resting upon sulphuric acid insulators attached to poles which were nailed to a wooden frame. The wire with the points covered a surface of 364 square metres. With this apparatus extended experiments were made, chiefly relative to the different kinds of conducting plates to the earth, but space does not permit me to discuss these experiments here. The galvanometer showed a current from the *earth towards*

the atmosphere, i.e. from the zinc plate to the "discharging-apparatus."

For the future I will call this direction of the current *negative*, and the contrary direction from the atmosphere towards the earth *the positive*. The deviations of the galvanometer were very variable, and the variations characterised by sudden movements, first in one direction, then in another. With this apparatus observations were made at Sodankylä during last autumn and winter. The deviation of the current was first exactly noted, after which a Leclanché element was introduced into the conductor, first with the positive pole towards the earth, and then towards the mountain. By this process a value was obtained at each observation of the electromotive force in the circuit of the current. This consisted of two kinds, viz. one arising from the contact of the zinc plate with "earth" (here water), the other from the effect of the electricity in the air upon the apparatus. The first kind varies very little. Regarding the observations at Sodankylä it has been remarked that they showed, as I have said, a negative current, which however became sometimes positive in October and November, and particularly when the aurora borealis was visible.

The daily observations of the atmospheric current were made at Kultala in the same manner as at Sodankylä. During the months of January and February three more "discharging apparatus" were constructed close to this station, and another conducting wire was placed on Mascart insulators. Fig. 2 shows the position of the apparatus, whose elevation was as follows :—

	Height above the River Ivalo		Height above sea-level
I.	324 metres	...	484 metres = 1630 feet
II.	334 ,,	...	494 ,, = 1664 ,,
III.	246 ,,	...	416 ,, = 1368 ,,
IV.	253 ,,	...	413 ,, = 1391 ,,

The distance between the station and the Apparatus I. was 3·626 km., and the distance between I. and II. 0·339 km. The following points are also shown by this sketch, viz. :—

o is a small observatory with a chimney ; o″ is the point where the conducting wires of the four apparatus were joined to two wires leading to the station.

With this apparatus numerous experiments were made, chiefly in the month of March, of the results of which the following is a brief *résumé* :—

(1) If two "discharging-apparatus" are placed at a given elevation and connected with a galvanometer there is no current, *i.e.* the deviation of the galvanometer equals 0.

(2) The Apparatus II., connected by a galvanometer to Apparatus I., always gave a positive current, the strength of which varied considerably. The following values selected as examples show the electromotive force, expressed in volts, during four days in March :—

March 18	March 19	March 20	March 21
0·1171	0·1161	0·1891	0·0530
0·1714	0·1400	0·3262	0·0530
		0·2632	
		0·2632	

These values were obtained by introducing a Leclanché element into the conductor in opposite directions. The electromotive force of this element was determined by comparison with a Daniell normal element. As there was a difference of 10 m. in the height of Apparatus II. and I., it may be noted that the electromotive force varied during the above four days between 0·0326 and 0·0053 volts per metre. The above two results show, *that the electromotive force of the electric currents of the atmosphere may be studied with regard to their strength, and its variations by means of two "discharging-apparatus" erected at different elevations.*

When two apparatus at equal elevations give zero, it clearly shows that the electromotive force observed only depends upon the difference in elevation, *i.e.* that electricity is distributed throughout the atmosphere, so that an electromotive force is produced, causing a current from the atmosphere towards the earth. The continued study with these four apparatus gave this singular result :—

(3) Close to the earth there is a stratum of positively electrified air, the potential of which is greater than that of the immediately overlying stratum, so that the potential diminishes from the surface of the earth to a minimum, to again increase at higher altitudes. The Apparatus III. and IV. situated in this stratum gave, combined with I. and II., a negative current, *i.e.* from the earth to the atmosphere.

This result, so soon arrived at, rendered rather difficult the projected work with the four apparatus, and the difficulty increased still more owing to the fact that the conductive power of the air diminishes rapidly nearer the earth. In order to study more minutely this peculiarity, two portable "discharging-apparatus" were constructed, consisting of a cross of thin boards, on which were placed several spirals of wires provided with points, the total number of points being thirty. These miniature apparatus, which I will call S_1 and S_2, were erected near II. upon the most elevated point of Pietarintunturi, S_1 being 2 m. above the earth, and S_2 at the top of a pole 9·1 m. high. Both were supported on Mascart insulators, and separately connected with the stations by conducting wires. With this apparatus a current was obtained from S_1 and S_2, *i.e.* negative, from the earth to the atmosphere. Great care was taken against any accidental defect in the conductor, or in the arrangement of the apparatus. The deviation obtained was very small, but quite measurable. The actual experiments with these apparatus were made on March 26 at 11 p.m., and lasted about three hours. As these experiments are of great importance I will describe the method followed.

The night was chosen as the most favourable time, the wind on the mountain being then very slight. The observers, Messrs. Granit and Roos, having telephoned that the experiments could commence, the current was measured by the galvanometer, S_1 being then 2 m. and S_2 at 9·1 m. above the earth ; *the deviation was negative.* S_2 was then lowered to the same height as S_1, when *the deviation was* 0. S_2 was elevated to its former position, and now the deviation was negative as originally. S_1 was now attached to two poles—3 m. high—furnished with Mascart insulators, and then raised by two men to a height of 4 m. *The deviation now became positive.*

This proved that the electric density of the stratum of air diminishes up to the point at which the current changed, and that the minimum density lay between a height of 2 m. and 4 m.

It would have been very interesting to have continued these experiments and further extended them, but this could not be done, as the stay on the mountain became impossible.

I went up on March 25 to examine the apparatus and convince myself that no mistakes had been made, and although the temperature was not more than − 12° C. it was impossible to work except with the back to the wind, for if the face was turned towards it, in a few moments the flesh became benumbed, and breathing difficult and painful. On the mountain there was nearly always wind, but its strength was less at night.

These experiments with the portable apparatus will be resumed next spring at Sodankylä under the superintendence of Mr. Biese, but as it is very probable that the electric state of the atmosphere will then be totally different, it is impossible to foretell whether they will give the anticipated results.

(4) From the stratum which lies some feet above the earth the electromotive force increases with the differences in height of the "discharging-apparatus." It has not been possible to determine exactly the laws which regulate this increase, but it is believed that the electromotive force increases more rapidly than *in proportion to the difference in height.*

The above results were obtained on clear days. The moisture of the atmosphere affects the resistance of the conductors, and appears also to act upon the electromotive force.

On one of the small apparatus, S_1, a number of points were furnished with wicks soaked in petroleum ; when these were lighted the effect was measured, and it appeared that the resistance diminished a little, but the electromotive force remained unchanged. Further results obtained from the observations must depend on a detailed examination of the materials collected.

Study of the Luminous Phenomena caused by the "Discharging-Apparatus."—Before passing to a final *résumé* of the results of these researches, I will refer in general terms to the meteorological character of the year, which are very important in relation to this subject. It is very seldom that the winter in Lapland is so mild as the last one was. There was not much rain or snow, but it snowed nearly every day, so that the days when there was a clear sky can easily be counted. It is only in perfectly clear weather that the luminous electric phenomena are visible, and this only happens when the moonlight is not too brilliant. Consequently there were very few evenings when the luminous phenomena could be successfully observed.

Another remarkable circumstance proves that the electric forces worked under abnormal conditions, viz. by the small number of auroræ appearing, which does not amount to one-tenth of the normal number according to the latitude, and except in three cases their intensity was very feeble. The cause thereof is to be found, I believe, in the constantly falling snow and the comparatively high temperature. Even the diffuse luminous phenomena which were seen so often during the winter of 1882-83 (see my former report), and which gave the spectral reaction of the aurora borealis, were very rare.

In fact, according to all reports, the characteristics of this winter are quite contrary to the preceding one, which is the more surprising as we are now in a maximum period of auroral manifestations. There have indeed been very few evenings on which the luminous phenomena could be studied, and the best of them have nearly always been accompanied by a full moon. The contributions which the expedition has been able to make to the study of these phenomena are therefore relatively small, but sufficiently important. We know from our former experiments that the "discharging-apparatus" *produces* a *luminosity*, sometimes in the form of a cloud-light, sometimes in *rays* which rise above the apparatus. The diffuse luminosity which always gave the spectral reaction of the aurora was produced very easily. *It was distinctly seen above the apparatus at Sodankylä, sometimes even with the naked eye, and very often with the spectroscope.*

As early as the autumn of 1882 Mr. Biese discovered that it was possible to obtain a spectral reaction of the aurora to the south-south-east of Sodankylä, a few degrees above the horizon, in the direction of the mountain Luostatunturi, while to traces were visible elsewhere. During the autumn of 1883 the same reaction was sometimes obtained from the mountain Komattivaara, although it could not be perceived in the above-mentioned direction. This luminous phenomenon was also very distinctly observed on the following nights, viz. :—

On the evening of November 1, when a strong wind from the west had chased away the clouds, an aurora was seen which commenced with a fairly regular arc in the north-north-west. The arc touched the eastern horizon at about 20° north of Komattivaara. While the reaction was obtained along the whole length of this arc, it entirely disappeared at this point of 20° from the horizon between the foot of the arc and the mountain. Moreover, this was distinctly shown as the slit of the spectroscope was directed towards the discharging-apparatus. On the southern side of the mountain the reaction again disappeared completely. As a general rule, the study of this luminous phenomenon was made at a distance of 5 km., but on two occasions rather closer. On November 12, in spite of the moonlight, moist air, and snow, a distinct reaction was obtained at a distance of 1 km. That evening the phenomenon was very brilliant, appearing like a moving luminosity along the whole apparatus, with a diffused radiating fan of light above. It was observed for fifteen minutes.

At Kultala the luminous phenomena were generally of greater intensity, but the majority of them could only be seen by means of the spectroscope, chiefly because on the most favourable occasions the moonlight was too bright. In order to obtain another proof of the electric origin of the aurora borealis, the expedition was furnished with a double Holtz machine, which, in spite of its fragile construction, arrived safely at its destination. When this machine was connected with the circuit of Apparatus I., with the positive pole towards the earth, the luminosity was more distinct. This was noticed as early as December 17 at Sodankylä, when the machine was connected with the conductor from Komattivaara, but the more exhaustive studies were made at Kultala. The observations, which were always made from the house O (see the sketch), have the following dates, viz. :—1884 : January 27, February 3, 4, 6, 7, 8, 12, 16, 20, 24. They were made by Mr. Biese and myself, and we have a report of each evening, that of February 3 being written by me, the others by Mr. Biese. We detail below those of February 3 and 7.

February 3.—Arrived at the Observatory at 6.30. The moon had risen, and shone brightly on the tops of the mountains ; no trace of the aurora could be seen either by the naked eye or the spectroscope. At a telephonic signal the Holtz machine was connected with the conductor, the positive pole being placed towards the earth. But in spite of the closest attention no trace of auroral light could be discovered. Presently, however, the moon became covered with a haze (nimbus), and the brightness of its rays diminished by one-half ; when this had lasted about half an hour, a luminous phenomenon in the shape of white clouds rose in flames from Apparatus I. *This gave the reaction in the spectroscope, and was very distinct, even to the naked eye.* At a signal, the machine was again put in motion, and now the flames followed each other every time, giving the reaction in the spectroscope. This reaction had sometimes a certain peculiarity : although the slit of the spectroscope was very straight, the line of the aurora was rather broad, and was followed by a continuous and very distinct spectrum towards F. At eight o'clock the machine was stopped, and the flames became fewer and feebler. At 8.15 p.m. the machine was again put in motion, with the same result as before. Presently a fog covered the summit of the mountain, and the experiments ceased at 8.40 p.m.

February 7.—The clouds were about 5 C S. (5/10 cirro-stratus), hence the reactions could only be obtained as projections upon the bright spectrum of the moon. Now and then a very feeble reaction was obtained towards the north and west, but the Apparatus I. gave none of them. However, when the Holtz machine was put in motion, a very distinct one was obtained, particularly when sparks were emitted. After a Geissler tube had been placed in the conductor of the machine the reaction became still more intense, and was very distinct when the discharge was accompanied by sparks. Never had I obtained so intense a reaction. Mr. Biese again remarked that no absorption-band had been observed near D in the spectrum of the moon, although its intensity varied considerably. From these data may be inferred :—

(1) That the "discharging-apparatus" produces on certain occasions a diffuse light which gives the spectral reaction of the aurora borealis.

(2) That a Holtz machine placed in motion in the conductor intensifies the phenomenon, if it already exists, and may even produce it under favourable external conditions.

(3) This luminous phenomenon is invisible to the naked eye if the moonlight is very bright, but even then the spectroscope often shows its presence.

After my experience of the power of the "discharging-apparatus" to produce luminous phenomena in the *form of rays*, I thought the phenomenon would appear easily. The following conditions are however, I have discovered, necessary for this : *a clear sky*, *low temperature*, and a *relatively low barometer*. These conditions have been very rare this winter, and when they have been present it was in an imperfect manner. However, the phenomenon was seen twice, viz. on February 27 and March 2, according to the following reports by Mr. Roos :—

February 27, 1884.—From the point O a feeble auroral arc was observed extending from west to north-north-east, the intensity of which gradually increased. At the same time there appeared in the direction of Pietarintunturi, above the arc but not connected therewith, a sheaf of very intense rays, which moved rapidly westward and disappeared after passing the northern line. Not a single ray was visible in any other part of the sky.

March 2.—Messrs. Granit, Ross, and myself observed from this point an aurora which rapidly increased in intensity, and formed a corona as early as 8 o'clock. I immediately went to point III., in order that the luminous phenomena which might appear above the apparatus at Pietarintunturi might be observed from two points simultaneously. About 10.30 I perceived a very intense ray in the direction of Apparatus I., leaning at first a little to the east, but rising by degrees like a radiating sheaf, with a slight westerly direction. The phenomenon lasted from thirty to forty seconds. On telephoning to Mr. Granit, who remained at point O, he replied that no luminosity was visible above the apparatus. Afterwards, and at short intervals, I three times saw a feeble ray in the same direction, but of different aspect. The ray, which was vertical, appeared of equal size and of a pale yellow colour. Although feeble it was very distinct. According to Mr. Granit no rays could be observed from point O, either above the apparatus or around the mountain for a space of about 15° on either side, and on this occasion the moonlight was very bright, which, together with the intense aurora, rendered the observation of the luminous phenomena very difficult, and besides this, the distance from O to I. is 2·45 km., while from III. to I. it is only 1·56 km.

If any doubt remained as to the first observation, *i.e.* as to whether the rays were above the mountains or not, the second, taken on March 2, is quite conclusive. If Mr. Granit could perceive no rays at point O, at a distance giving an angle of 15°

at two sides of the mountain, that merely proves *that the light was too feeble to penetrate a distance of 2·45 km.*, though it was visible at 1·56 km. The reflection of the moonlight was also stronger at point O than at III., because on this occasion the moon was nearly north east.

It is not easy, I confess, to make a *résumé* of the results arrived at by the researches of the Finnish Expedition to Lapland concerning the electric currents of the earth and the atmosphere, chiefly owing to the circumstance that the materials are not as yet fully analysed, but the following may, however, be accepted as quite certain, as they are based on actual observations :—

The aurora borealis, which has long been a disputed enigma, is the result of an atmospheric electric current.

This auroral current can be measured, and, as a rule, studied, by the methods employed by the Expedition.

The "discharging-apparatus," or network of pointed conductors, used by the Expedition, has very often produced a diffuse light which gave in the spectroscope an auroral spectrum. Under very favourable conditions the light appeared in the form of rays above the apparatus.

With a Holtz electric machine the diffuse light may be *produced* under favourable conditions, and if it exists already it may be considerably intensified by the same means.

For the study of terrestrial electric currents a method has been found which, while avoiding all foreign influences, permits of the current being measured, both as regards absolute strength and as regards the exact laws which regulate it.

From these experiments it seems that the existence of a belt of terrestrial currents similar to the belt of auroral currents is very probable.

SELIM LEMSTRÖM

Helsingfors University

ON THE NATURE OF LICHENS

IN the *Journal* of the Linnean Society for December 12, 1884 (Botany) there appears a review of the "Algo-Lichen Hypothesis," by the Rev. J. M. Crombie, F.L.S., from the strongly conservative point of view of Nylander, on which I desire to make a few remarks as a critical student of Botany at large.

Mr. Crombie cites, as a fatal objection to Schwendener's hypothesis of symbiosis between the lichen proper and the alga forming its gonidia, that in other cases of vegetable parasitism "the hosts usually become speedily exhausted and finally perish, often involving in their death that of the parasite itself;" whereas here we have "a parasite exceeding in size and number of cells by many hundred times the nourishing plant which it invests." It is now over six years since I sent you, with reference to this very point, a brief note on the subject, which probably escaped Mr. Crombie's notice by its brevity, and of which I reproduce the substance. The essential elements of nutrition of a fungus, so far as we can judge from culture experiments, are as follows :—(1) *ash constituents;* (2) *nitrogen* in the form of nitrates, nitrites, or ammonia ; (3) *carbon and hydrogen combined* in the form of tartrate, carbhydrate, or fat, &c. An alga requires only Nos. 1 and 2, deriving No. 3 by assimilation from the carbon dioxide of the atmosphere and water. The lichen hyphæ, aided by excretion of carbon dioxide, can dissolve the ash constituents, No. 1, from the substratum, taking them up by the rhizoids ; the rain probably brings No. 2 in the form of traces of nitrates ; No. 3 can only be formed by assimilation in the algal part or gonidia of the lichen. But, to obtain the carbhydrates, No. 3, there is no need for the hypha to penetrate the gonidium or to molest its protoplasm, as the algal cells have a cellulose wall, of which the outer layers undergo constant gelification and renewal. Into this it is that, as shown by Bornet ("Sur les Gonidies des Lichens," *Ann. Sc. Nat. Bot.*, ser. 5, xvii.) the hyphæ penetrate ; and if they only lived on this, once formed, there would be no strain whatever on the resources of the alga. But, even if they stimulate an abnormally rapid cellulose formation, the injury need not necessarily be severe. We see oysters living well, though their shells are burrowed by the sponge Cliona ; they produce new layers of shells far faster than when they are sound, but are otherwise uninjured.

An unlooked-for confirmation of these views is found in Johow's account of the Hymenolichenes (in Pringsheim's *Jahrbücher*, xv., part 2), where, "*in consequence* of the unusually close and perfect investment of the gonidia" by the hyphæ, the gelatinous investment of their cell-wall completely disappears. This is in marked contrast with the usual state of things as figured by Bornet.

De Bary puts the case thus :—"With their growth (of the algæ) the assimilation of carbon dioxide persists in their protoplasm with its chlorophyll, and produces organic carbon compounds utilisable by the fungus. At the same time the rhizoids of the fungus ramify on and in the substratum, and bring the mineral pabulum required. These two processes support and complement one another (*Vergleichende Morphologie u. Physiologie d. Pilze*, &c., 1884, p. 425).

It is further noteworthy that, if the growth in size of the gonidia is often favoured by their inclosure in the lichen-thallus, their rapidity of multiplication by division is notably impeded ; while spore-formation, &c., remains in complete abeyance.

Mr. Crombie recalls the absence of algæ in places where lichens abound, *e.g.* "granitic detritus and boulders towards the summit of lofty mountains." This follows from the fact that the algæ alone cannot there obtain, unassisted, their papulum No. 1, the mineral substances or ash constituents. The absence of the fungi *alone* from these localities simply shows that they cannot live without their algal gonidia.

Mr. Crombie gives as an essential distinction between the hyphæ of lichens and those of fungi the character of their cell-wall : "perennial, firm, penetrated by lichenin, thick, imputible, and insoluble in caustic potash in the former ; caducous, very soft, with thin walls, readily putrifying on maceration, and, on the application of caustic potash, immediately becoming dissolved."

As regards the thickness and permanence of the walls, it needs hardly to be recalled how much this character varies in different parts of the same fungus, and notably in corresponding organs of different members of the same group of fungi : compare *Polyporus* and *Boletus*, *Schizophyllum* and *Coprinus*. As to the presence of lichenin, De Bary states (*op. cit.*, p. 10) that in at least three gelatinous fungi—*Hyduum erinaceus*, *Polystigma*, and *Hysterium macrosporium*—the hypha turns blue on the application of aqueous solution of iodine, that is, gives the "lichenin reaction."

As regards the alleged solubility of fungus hyphæ in caustic potash, I am at a loss to understand it, having, like most workers, been in the habit of using this reaction "for clearing" vegetable preparations to demonstrate the presence of parasitic fungus hyphæ, which would be impossible if it dissolved them. And I find no account of this solubility of fungal cell-walls in Hofmeister's very complete "*Lehre von der Pflanzenzelle*," or in De Bary's above-cited work.

A misapprehension on the part of the author is to think that the Schwendenerian school have overlooked the "cellular cortical layer" when they speak "as if only two elements entered into the structure of lichens, viz. hyphæ and gonidia." This is due, so far as it is true, to the general recognition by mycologists that such pseudo-parenchyma as that composing the cellular cortical layer of lichens, of fungus sclerotia, &c., is only an extreme modification of the hyphæ. But, far from being ignored, it is figured and described by Sachs ("Text-Book of Botany," (1st Engl. ed., Figs. 188, 189, and explanation), who says : "The upper and under cortical layers [of *Sticta*] also consist of hyphæ, which, however, . . . consist of shorter cells, and are united without interstices, forming a pseudo-parenchyma." Its formation is also described by Bornet (*op. cit.*, p. 97), and De Bary writes (*op. cit.*, p. 436) : "The hypha-branches forming the cortical layer ('Rindenschicht') are united without interstices, save in certain species of *Rocella*. They are either recognisable as such, having the lumina of their segment-cells evidently elongated and cylindrical, even though shorter than those of the medulla, or else they are formed of short isodiametric rounded prismatic cells, giving the cortex the structure of a pseudo-parenchyma, which is often extremely regular and neat ('*zierlich*'). . . . The structure of these cortical layers shows great similarity to that of many sclerotia."

In the latter half of the paper Mr. Crombie exposes at length the view that the gonidia originate in the cellules of the hypothalline and cortical layers,[1] and illustrates it by figures. In this no attempt is made to show the part played by the protoplasm in the process, an omission which is an implied confession of the inadequacy of the weapons, optical and technical,

[1] As regards his statement that "specimens illustrating the earlier stages of lichen growth appear to be unknown to the supporters of Schwendenerianism," it is only necessary to revert to Bornet's paper, p. 97.

employed in the investigations on which the view is based.[1] Considering that chlorophyll bodies and plastids generally are unknown in hyphæ of all kinds, and in view of the recent researches on the part played by nuclei in cell formation, we had a right to expect some allusion to these matters in a research dated 1884. As regards the optical powers employed, two instances will suffice. Fig. 7 is stated to be highly magnified; *7a*, a more highly magnified part thereof, is only enlarged 275 diameters, and this is the highest power used! Fig. *7a* is stated to show "the separated gonidia [of *Psoroma hypnorum*] inclosed in the cellules [of the cortex], after Nylander." It represents, in fact, a homogeneous green spot separated by a narrow blank space from the concentric double black outline. Fig. *2a*, "Gonidia [of *Lecanora gibba*], as seen inclosed in the cellules of the pseudo-parenchyma, magnified about 270 diameters," only differs from *7a* in the black outline being single instead of double; and these two figures are the only ones professing to illustrate the actual formation of the gonidia!

So much for the formation of the gonidia from the hyphæ or the derived cellular cortical layer. Of the inverse origin of hyphæ from gonidia, the author gives no hint; yet, surely this should be taken into consideration also in a complete account of the lichen as a simple organism? Mr. Crombie states that "*Sirosiphon*, *Hormosiphon*, *Scytonema*, *Stigonema*, *Cora*, *Dichonema*, *Chroolepus* or *Trentepohlia*, *Nostoc* and *Glœocapsa* (at least in part), *Gongrosira* and *Phyllactidium*, have now to be removed from the class of the algæ," having, "in consequence of the discovery of their fructification, been proved to be lichens." Such papers as those of Bornet and Johow are in complete discordance with this view, except as regards *Cora* and *Dictyonema* (or *Dichonema*). Mr. Crombie seems to be unaware that the discovery of a *hymenomycetous* fructification in these very genera of lichens by Mattirolo ("Contribuzione allo Studio del genere *Cora*," in *Nuov. Giorn. Bot. Ital.*, vol. xiii. 1881), confirmed and extended by Johow, is regarded by most botanists as the very coping-stone of the symbiosis theory founded by De Bary and Schwendener; but their papers are not referred to.[2]

I may say that I have personally hunted through many a *Nostoc* colony without finding a trace of hyphæ; and there is no record of the transmutation of a *Nostoc*-cell into a lichen or fungus hypha. Yet this is wanting to show that *Nostoc* is the immature form of a lichen. So I have frequently seen *Glœocapsa* colonies permeated by hyphæ, which could often be traced to septate (probably lichen) spores, but, like all other observers, never to a green cell. *Gongrosira* has been demonstrated by Stahl to be at least in part the resting form of *Vaucheria* ("Die Ruhezustand der *Vaucheria geminata*," in *Bot. Zeit.*, 1879, p. 129, t. ii.), and must henceforward rank only as a form-genus. *Phyllactidium* is another form-genus, comprising young forms of genera so distinct as *Coleochæte* and *Mycoidea*, Cunn.

I have abstained from reviewing the purely critical appreciation of the works of Schwendener, Bornet, Rees, Stahl, &c., though Mr. Crombie's treatment thereof seems to me decidedly offhand. But I trust that in my remarks on his positive arguments in favour of the unitary theory of lichens, I have not exceeded the bounds set by the respect all must feel towards his honest and arduous work on the classification of so difficult a group.

MARCUS M. HARTOG

Queen's College, Cork

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—A temporary Pathological Laboratory has been fitted up for Prof. Roy, and it is proposed to vote 400*l.* for apparatus.

Downing College has now a capital opportunity of appointing a scientific man as Master, owing to the death of Dr. Worsley.

Mr. C. Dixon has been appointed a Demonstrator of Mechanism and Applied Mechanics in place of Mr. J. H. Nicholls, resigned.

A discussion took place last Friday on the Report as to a new Chemical Laboratory. Prof. Liveing stated in forcible terms the inadequacy of the present laboratories, which were inferior to those of many schools. He could not classify students; he had no class-rooms, and literally no provision for research. Cambridge was subjected to severe competition; a new University in the north of England was supplying considerable means of research; and before long it must be expected that the plans for a Teaching University for London would be carried out. It would be economical to make good provision while they were about it. The estimated sum of 30,000*l.* was as low as would provide suitable accommodation. The chief objections urged against the proposal were as to the magnitude of the sum in proportion to other requirements and to the funds at the disposal of the University. Prof. Humphry made a vigorous appeal to men of wealth, who might find in Cambridge many objects worthy of their munificence. Cambridge laboured under the double disadvantage of being poor and of being thought rich.

THE following courses of Lectures and Demonstrations in special branches of Physics will be given in the Physical Lecture Room and Laboratories of the Science Schools, South Kensington:—(1) Connection between Sound and Music. Six Lectures and Demonstrations by R. Mitchell, at 2 p.m. on February 23, 25, 27, March 2, 4, 6. (2) Certain Optical Measurements. Eight Lectures and Demonstrations by H. H. Hoffert, B.Sc., at 2 p.m. on March 9, 11, 13, 16, 18, 20, 23, 25. (3) Electrical Measurements. By C. V. Boys, A.R.S.M., at 2 p.m. on April 13, 15, 17, 20, 22, 24, 27, 29; May 1, 4. (4) The Chemical Action of Light. By Capt. W. de W. Abney, F.R.S., at 2 p.m. on May 6, 8, 11, 13, 15, 18, 20, 22. The above courses are open without fee to all second and third years' regular students of the Normal School of Science and Royal School of Mines, on their giving to the Registrar a written recommendation from the Professor or Lecturer whose classes they are attending at the time. The fee to others attending the courses are: for each separate course, 10*s.*; for all the courses, 30*s.* Such fees are payable in advance to the Registrar of the Normal School of Science and Royal School of Mines. These courses will only be given if a certain number of applications are made a week before February 23. Those intending to join are therefore requested to do so as soon as convenient. All the courses are open to women.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 29.—"On the Structure and Development of the Skull in the Mammalia. Part III. Insectivora." By W. K. Parker, F.R.S.

Although this paper is confessedly only a fraction of what is necessary to be done in this polymorphic order, it shows at least how difficult a group it is to handle. For the Insectivora are set in the midst of the other mammalia—low and high. They might be called the biological stepping-stones from the Metatheria to the Eutheria.

One thing can be done, even now, with our present fragmentary knowledge of the structure and development of the insectivorous types—we can assure ourselves that these types are immediately above the Marsupials, that they have the bats (Chiroptera) obliquely above them, that their nearest relations must be sought for amongst extinct Eocene forms, and that, lowly as they are, and arrested and often dwarfed to the uttermost (so that nature could not safely go further in that direction), they are rich in prophetic characters that have come to perfection in larger and nobler types.

I think it will not be denied that in the ascent of the types the Chiroptera are above the Insectivora, and, as it were, a sort of special "new leader" from that stock, and that the Insectivora are more or less transformed modifications of the marsupial type. I suspect that the existing Insectivora just yield the zoologist one of his groups of types classed together because he knows not what else to do with them; they are not a proper, clear, special branch or "leader" of the mammalian life-tree. They form one group under one designation, just as the poor of this metropolis form a group; their special mark is simply lowliness; they differ *inter se* almost as much as the whole remainder above them differ. The higher forms, however, because of their elevation, can afford to be sub-divided again into order after order. If we could descend and see the transforming and newly transformed Placentalia of the Eocene epoch, then the morphologist and the zoologist would find common ground; the taxonomy of the latter, however, would be as useless as the titles and distinctions of modern society to some undeveloped race of savage men.

The best type of Insectivore for general comparison is th

[1] The wonderful results obtained by Mink and Müller in their researches on the "Microgonidia of Lichens" show that *high powers alone* do not suffice for scientific investigation. Mr. Crombie has rightly rejected their views.

[2] Johow's could hardly have reached England before the composition of Mr. Crombie's paper. Mattirolo's dates from 1881.

hedgehog (*Erinaceus europæus*), as it shows the least suppression of parts, and the best development of that which is diagnostic, so to speak, of the order. In it the great investing bones of the skull are similar to those of the marsupial, but the nasal and squamosals are smaller, and the frontals are larger. In the hard palate there is a considerable relapse, as in marsupials, certain tracts of bone being absorbed, but it has no mesopterygoids, and only *five* vomers, yet the anterolateral pair are well developed. Moreover, the tympanic region has only one annulus, the outer bone; there is no separate os-bullæ. Instead of the latter there is a crescentic shell of bone which grows from the basisphenoid, greatly increasing the size of the tympanic cavity. In the endoskeleton in front of the tympanic cavity there is a remarkable ridge of bone growing outwards from the alisphenoid. That ridge is the remnant of the alisphenoidal tympanic wing of the marsupial, and the shell of bone growing from the basisphenoid is the same morphological element as the separate os-bullæ, but it has lost its independence. The higher mammalian type is fully reached in the thorough freedom of the alisphenoid from the general cranial wall. This character, indeed, is intensified into the special diagnostic of an insectivore, for it lies almos, wholly outside the orbitosphenoid. Here the sphenoidal fissuret which in this case lets out the second branch of the fifth, but not the optic nerve—that nerve having its own foramen in the orbitosphenoid—is not a mere gap, but a *side passage*, or a sort of sphenoidal corridor, right and left. In these things the hedgehog is higher than the marsupial, but in some others it is lower, or more archaic. These latter characters, which suggest an uprise from a more general type than the existing metatheria, are—

(1) The development of solid hyaline cartilage in the pterygoid region, a remnant of the pterygo-quadrate of the Ichthyopsida.

(2) The presence of a persistent pituitary hole, which is connected with a curiously specialised structure only seen in typical insectivores, namely, a hollowing out of the basis cranii beneath the pituitary region.

(3) A third archaic character, not seen in the existing marsupials, is the huge relative size, long persistence, and separate distal ossification of Meckel's cartilage, so that in the embryo hedgehog, and even in the nestling, the primary lower jaw is as large as in fishes generally, scarcely excepting the Selachians.

The ossicula auditûs are typically Eutherian; we have lost the imperforate stapes or columella, the interhyal is very small or absent, and the malleus and incus are much like what we find in the higher mammals generally. The pneumaticity of the skull is much reduced: the olfactory region is almost double the relative size of that of a Marsupial. In the head of another family of the Insectivores, namely, the mole (*Talpa europæa*), there is much that is in accord with what is found in its distant relation, the hedgehog, but in it there are evident signs of degradation and of relapse into what is Marsupial in character. The nasal labyrinth is relatively immense, and the skull-walls below, laterally, and behind are as exquisitely pneumatic as in the flying Marsupial (*Petaurus*), the bird, or the crocodile. The swollen basis cranii, all air galleries within, is so excavated that the hinder sphenoid, both base and wings, largely helps the flat single tympanic to form the drum cavity. The pituitary hole does not exist, but there is a considerable pterygoid cartilage. The ossicula *in the adult* are normal, but a curious special character is seen in the ossification, in the young, three parts grown, of the sheath of the stapedial artery, which for a time holds the stapes in its place. It is, however, absorbed afterwards, but remains in the related genus *Myogale*. In nearly half-grown young moles the malleus is quite like that of the marsupials; it is an evident "articulare," with copious wild growths of bone, sub-distinct, which answer to the "angulare" and "supra-angulare" of a reptile or bird. This malleus in its articular part has two endosteal and one ectosteal bony centre.

Meckel's cartilage, long continuous with the malleus, is nearly as massive as in the hedgehog, and has a more distinct separate ossification in its sub-distal part, a long, independent, but temporary *hyobranchial bone*.

The mole shows a most remarkable development of the endocranium, which, twenty years ago, suggested to me that its skull retained unmistakable monotrematous characters. In large young of the *Echidna* and *Ornithorhynchus* the solidity of the chondrocranium is immense, like that of a *Chimæroid* Selachian. and the investing bones are thin and splintery. I have not made out the mode of ossification of the inner skull in those types, but in *spirit*, if not in the *letter*, the mole agrees with them, that is, in the great development and independence of the inner skull. The opisthotic bone ossifies the normal petro-mastoid region, whilst the prootic bony centre begins in its right place on the front edge of the cartilaginous capsule, and then runs away from it into the wall of the skull. Thus there is a large bony tract in the temporal region between the squamosal and the large interparietal, which is not one of the ordinary ectocranial bones, but an endo-cranial bony tract overshadowing and yet imitating the true temporal bone or squamosal. This bone is represented by three separate centres in osseous fishes, namely, the prootic, pterotic, and sphenotic, whilst their true auditory region is partly ossified by the epiotic and opisthotic; the epiotic is only sub-distinct in the mole. If I am asked why I dive so far down for my illustrations, instead of being satisfied with what reptiles and birds would show me, my answer is that these are often of no use for comparison, as they are as thoroughly specialised for their own mode of life as the Mammalia generally, and are as completely, and often more completely, transformed from the original archaic type or types. Thus the mole, like most of the Edentata lately described by me, suggests as the root stock of the Eutheria generally, not marsupials (Metatheria), as we know them, but prototherian forms in which, in ages long past, the existing monotremes and marsupials had a common origin. The shrew (*Sorex vulgaris*) represents another family of the Insectivores, the Soricidæ. It combines the characters of the mole and hedgehog with peculiarities of its own that are manifestly due to dwarfing; many things are suppressed, as if there was not room in so small a skull for their development. The pituitary hole reappears, and the pterygoid cartilage, but the tympanic wings of the alisphenoid and of the basisphenoid are gone. The malleus does not show itself so unmistakably marsupial, and Meckel's cartilage is slenderer. The sheathing alisphenoids are well seen, the squamosal is extremely small, low down, and devoid of a jugal process; the jugal bone is suppressed. The prootic wing is present, as in the mole.

So much for the British representatives of these families of the Insectivora—the Erinaceidæ, Talpidæ, and Soricidæ. The Mascarene Insectivora are so evidently related to each other as to suggest at once a common origin; these are the Centetidæ, the largest of which is the Tenrec (*Centetes ecaudatus*); the other genera treated of in this paper are *Ericulus*, *Hemicentetes*, and *Microgale*.

These are almost typical Insectivora, but they agree with the shrews in having the jugal bone suppressed; they are also more marsupial than our native kinds. In these types the normal characters of the skull of an insectivore are combined with a remarkable marsupial tympanic wing to the alisphenoid, but the os-bullæ is not free, it is merely an outgrowth of bone from the basisphenoid. The pituitary hole is present and in the large species the curious basi-cranial excavation; the optic foramina also and the sphenoidal side passages are remarkably developed. As in the genus *Phalangista* among the marsupials, and *Sorex* and *Talpa* among the British Insectivora, the antero-lateral vomers are evidently suppressed, or have a very temporary independent existence: the postero-lateral vomers are rather small, as in the hedgehog. In the embryo the main vomer is *relatively* as large as in the embryo whale, and is curiously cellular or spongy. In nestlings this one primary azygous centre has broken up into three: one, the largest, above, and two lesser below, sheathing it, as it sheaths, the base of the nasal septum. Now this multiplication of the vomers proper is thoroughly marsupial. It is unique, as far as I know, in the mode of its sub-division into secondary bony centres. In the African (Continental) family the elephant or jumping shrews (Macroscelidæ), as illustrated by the largest forms, *Petrodromus* and *Rhynchocyon*, we have a curious mixture of marsupial or metatherian and eutherian characters, so that they are aberrant as insectivores; the marsupial characters are most remarkable. These are: (1) the absence of an optic foramen in the embryo; (2) the alisphenoids scarcely overlapping the orbitosphenoids; (3) the tympanic wings of the alisphenoids are well marked, hollow shells in the embryo; (4) large antero-lateral vomers and postero-lateral vomers as large as in average marsupials, and, as in many of them, meeting and uniting at the mid-line; (5) a large distinct "os-bullæ," which makes a tympanic cavity as large as, and much like that of, *Petaurus* or *Phascolarctos*. On the high eutherian side we have, in the embryo, frontals as large as the parietals, and, strangest of all mammalian specialisation, a long *proboscis*, composed of thirty double rings of cartilage, a

structure quite similar to the proboscis of an elephant. The mesopterygoids are suppressed, but the pituitary hole is present.

I now come to a type for which no place can be found in our systems of zoology, but for which the late Prof. Peters, in despair, lodged with the Insectivora; I refer to the flying cat (*Galeopithecus*). This genus forms a family by itself, and yet has only two species; it should form an order, as the Hyrax does.

These two species of flying mammals are full of *remnants* of what is old, and *rudiments* of the *new*. I put them between the most archaic (marsupials) and some of the most curiously modified Eutheria, the frugivorous bats, and survey them from these two widely separate standpoints; but they possess that which neither phalanger nor bat will account for or explain.

With a flat, outspread, foliaceous skull, as completely ankylosed as that of any bird, and as thoroughly pneumatic in its post-orbital region, we have one of the largest and most perfect *hard palates;* with the upper incisors partly suppressed, the lower incisors well developed and utterly unique, and the premolars and molars strong for grinding. The cheek-bones and the squamosals are large and thoroughly marsupial, so are the small external pterygoid processes and internal pterygoid bones, and the very large mesopterygoids. I find no antero-lateral vomers, but Jacobson's organs and their protecting cartilages are *twice as long* as in any types yet examined, and the postero-lateral vomers are almost as well developed as in marsupials, whilst the main vomer is very large. The sphenoid bones are typically Eutherian, but the basisphenoid has beneath it, as in *lizards*, a small "parasphenoid"; this I find only in *G. philippensis*, and as yet in no other mammal. As in the marsupials, the jugal or malar helps to form the glenoid cavity, and the squamosal is as large as in *Cuscus*, the lowest of the *Eastern Marsupials*. The single flat tympanic bone, with its ossified and compressed meatus, is very remarkable; but this part of the skull corresponds neither with the marsupials nor the insectivores, and this is true also of several other of its characters.

Those things in which it agrees with the marsupials are not the same as in the hedgehog; it differs from both insectivores and marsupials in its own peculiar way, and in some things is more archaic than either. This type appears to me to be a waif from a large group of forms that were beginning to be transformed out of the metatheria into the flying eutheria (Chiroptera), certain of which, this living type among the rest, being arrested at the general level (or platform) of the Insectivora; they are equal to, rather than members of, the order Insectivora. The last type to be mentioned is the Tupaia, an Eastern form, rather high in position, yet combining characters for the first time seen in the Mammalia, namely, a perfect orbital ring, with old metatherian structures, such as the large os-bullæ, the small external and internal pterygoids, and a somewhat absorbed hard palate. The last three kinds, *Rhynchocyon*, *Galeopithecus*, and *Tupaia*, all show a curious mixture of that which looks upwards to the highest types, and of that which has been retained from the lower and more archaic forms of the mammalian class.

Anthropological Institute, February 10.—Francis Galton, F.R.S., President, in the chair.—The election of Douglas W. Freshfield, Lieut.-Col. J. Augustus Grant, C.B., F.R.S., and Cuthbert Edward Peek, M.A., was announced.—Mr. H. H. Johnston read a paper on the people of Eastern Equatorial Africa. The races treated of extend over a region of Eastern Africa lying between the 1st degree north of the equator and 5° to the south, and bounded on the west by the 34th degree of east longitude, and on the east by the Indian Ocean. The forest country on the hills or along the rivers is occupied by resident agriculturists almost exclusively belonging to the Bantu family, ethnologically and linguistically, and the forbidding wilderness in the plains is ranged over by tribes of either Galla or Masai origin, both of which may be roughly classed with the Ethiopic or Hamitic groups. The Wa-taita are of medium height, and have fairly good figures, but the men are somewhat effeminate and slight-looking. In facial aspect there is much variation: the teeth are filed and sharp-pointed, and the ears are so misshapen by prevailing fashion that it is hard to guess at their original shape. The body is disposed to be hairy, but is carefully depilated all over, even to the plucking out of eyebrows, eyelashes, beard and moustache. The hair is allowed to grow only on the occiput, and here it is much cultivated, and pulled out into long strings, which are stiffened with grease and threaded well with beads. There are but slight traces of religion among the Wa-taita. They are afraid of spirits who are supposed to dwell in large forest trees, and perhaps for the reason that their dead are always buried in the forest. Their marriages are arranged first by purchase, but after the preliminaries have been settled, the girl runs away and affects to hide. She is sought out by the bridegroom and three or four of his friends, and when found is seized and carried off to the hut of her future husband. The Akamba, who live to the north of Taita, are a very roving, colonising people, and great hunters. One of the most interesting tribes are the Wa-tarata, who exhibit marked peculiarities in their language and ideas. They are of fair height, some of the men attaining to six feet. They frequently let the beard and moustache grow, and usually abstain from plucking out eyelashes and eyebrows. Circumcision is general. Marriage is a matter of purchase, but no sign of imitating capture seems to be practised here. They number about two thousand, and bear an excellent reputation among the coast traders for honesty and friendliness. Mr. Johnston described some of the chief characteristics of several other tribes with which he had come into contact during his visit to Kilimanjaro, and referred particularly to the languages spoken by the various peoples, one of the most interesting of which is the Masai, which has many characteristics not possessed by most of the other African languages.

PARIS

Academy of Sciences, February 9.—M. Bouley, President, in the chair.—On a new disposition of the revolving mirror for the measurement of the velocity of light, by M. C. Wolf.—On the determination of the ohm by the amortisement method, by M. Mascart.—On the velocity of the detonation in solid and liquid explosive substances, by M. Berthelot.—On the epipodium of some of the gasteropods, by M. H. de Lacaze-Duthiers.—Note on the skeleton of an extinct hyæna (*Hyæna spelæa*) discovered by M. Felix Regnault in the Gargas Cave, near Montrejean, by M. A. Gaudry. This cave hyæna appears to have been scarcely larger than the present spotted species, but the bones were thicker, so that it appears to have been a heavier animal. The author proposes to constitute it a distinct species, as *Hyæna crocuta*.—Remarks on the new volume of the annual series issued by the Observatory of Rio de Janeiro, and presented to the Academy in the name of the Emperor of Brazil, by M. Faye.—On a new refrigerator prepared for the study of physico-chemical phenomena, by M. R. Pictet.—On the treatment of vines infested by phylloxera with the sulphuret of carbon, by M. P. de Lafitte.—Observations on Encke's comet made at the Paris Observatory (equatorial of the West Tower), by M. G. Bigourdan.—On some remarkable anomalies recently observed in the appearance of the planet Saturn, by Père Lamey.—Observations of the solar protuberances made at the Observatory of the Collegio Romano during the year 1884, by M. P. Tacchini.—Note on the solar parallax deduced from the daguerrotype plates taken by the French Commission for the Transit of Venus in 1874. A new method of calculation, comprising nearly all the observations recorded, by M. Obrecht. The parallax of the sun as determined on these data is expressed by the formula

$$\pi = 8''{\cdot}8 - 0{\cdot}004\,\delta L,$$

where δL is the correction in seconds of the time for the longitude adopted for the station of Pekin, $L = 7$h. 36m. 30s.—On a theory of curves and surfaces admitting univocal correspondences, by M. S. Kantor.—On the equilibrium of a fluid mass to which a movement of rotation has been communicated, by M. H. Poincaré.—On the variation in the electric resistance of bismuth placed in a magnetic field, by M. Hurion.—Temperature of solidification for nitrogen and the protoxide of carbon: relation between the temperature and pressure of liquid oxygen, by M. K. Olszewski.—On the solution of the carbonate of magnesia by carbonic acid, by M. R. Engel.—On the action of sulphur on red phosphorus, by M. F. Isambert.—On the crystals of monazite occurring in the diamantiferous gravels at Caravalles, Province of Bahia, Brazil, by M. H. Gorceix.—On the β-hexachloride of benzine, by M. J. Meunier.—On the sensitiveness of the eye to different degrees of luminosity in the ordinary light usually employed for reading, writing, &c., by M. Aug. Charpentier.—On the modifications produced in the chemical composition of certain secretions under the influence of Asiatic cholera, by M. A. Gabriel Pouchet.—On the physiological action of cocoine, third note, by M. Grasset.—On the physiological action of the sulphate of cinchonamine, by MM. G. Sée and Rochefontaine.—On the optical inactivity of

cellulose, and especially of that which is separated from the solution of cotton in the ammoni-cupric reaction, by M. A. Béchamp.—On the *Bacterioidomonas ondulans*, a new organism recently discovered in the intestine of the black rat, by M. J. Kunstler.—On the passage of pathogenetic microbes from the mother to the fœtus, by M. Kourassoff.—On the microbe of typhoid fever in the human system: its cultivation and inoculation, by M. Tayon.—Influence of light on vegetation and on the pathogenetic properties of *Bacillus anthracis*, by M. S. Arloing.—On the veinous circulation of the foot, by M. P. Bourceret.—On the nervous system of the embryos of the Limaceæ, and on the relations of the octocyst with this system, by M. S. Jourdain.—On the nervous system of the Teniæ, by M. J. Meiniec.—On the tetraptera *Tetraplatia volitans*, Busch., by M. C. Viguier.—On the spermato-genesis of the decapod crustaceans, by M. Arm. Sabatier.—On the existence of land mollusks furnished with lungs in the Permian formation of the Saône-et-Loire, by M. P. Fischer.—On a new method of transmitting the mildew of the vine, by M. Fréchou.—Remarks on the late earthquakes in the south of Spain, by M. Macpherson.

BERLIN

Physiological Society, January 16.—Dr. H. Virchow, referring to the results of his investigations into the structure of the eye in different mammalia, communicated those which had reference to the zonula zinnii. He illustrated by diagrams the situation of this organ and the course of its fibres, set forth the various methods of examination, the efficiency of which he demonstrated by a series of preparations, and discussed the different views advanced on the subject of the canal of Petit and the ciliary apparatus. As the result of his researches he found that the zonula zinnii consisted simply of fibres, which at places where they were ranged closer to one another were connected by an intermediary substance, while at those where the fibres kept further aloof from one another no such intermediary substance was present.—Prof. Albrecht from Brussels, as guest, spoke on the morphological significance of the swimming-bladder of fishes. As was known, this bladder was either in open communication with the intestinal tube, or the connection between the two was obliterated, and in this latter case it might well be assumed that the communication in question had existed in earlier stages of development. Many naturalists were of opinion that the swimming-bladder was homologous with the lungs, which likewise represented a tube in communication with the intestinal tube—an opinion, however, decidedly opposed to the views of the speaker. For in all fish the swimming-bladder was placed supra-intestinally, or on the dorsal side, while the lungs are invariably situated infra-intestinally, or on the ventral side of the intestinal canal. If these two organs were homologous, the dorsal organ, in order to its transformation into a ventral, must, by some means or other, have made its passage around the œsophagus. The assumption, however, of either a right-sided or a left-sided passage, or, in fine, of a double division of the swimming-bladder, each of which had wandered downwards on one side, there to form together the two halves of the lungs, was a notion which laboured under difficulties and contradictions. Altogether, in the opinion of Prof. Albrecht, it was erroneous in any case to explain dorsal and ventral organs as homologous, and just as much so in the intestinal canal as in the brain. The swimming-bladder and the lungs were, on the contrary, rather completely heterologous organs. The best argument for the truth of this view was afforded by those fishes which possessed two bladders, a supra-intestinal and an infra-intestinal. Such a phenomenon would be absolutely impossible if these bladders were homologous. In point of fact, in the gymnodonts, diodonts, as well as tetrodonts, there were found a dorsal swimming-bladder, and, beside it, ventral air-sacs proceeding from the œsophagus, by means of which these fish were enabled to inflate themselves. These ventral air-sacs were homologous with the ventral lungs and heterologous to the dorsal swimming-bladders. There were, furthermore, fishes which, of the two protrusions of the intestinal canal, developed only the ventral, while the dorsal became absorbed. Such was the case in Polypterus, which possessed an infra-intestinal swimming-bladder, and in which, therefore, the homologue of the lungs was alone developed. There were, moreover, fish in which both protrusions became absorbed—the dog-fish, for example, which had no swimming-bladder whatever. An interesting support to this view of Prof. Albrecht's was afforded by the fact that, even in the case of mammalia in which the ventral protrusion of the intestinal tube had developed into lungs, remains of the dorsal swimming-bladder were presented in a rudimentary form. Such the speaker took to be the diverticula of the œsophagus, a not uncommon pathologic occurrence in man, which were always dorsal and occupying a position opposite to the entrance into the larynx. These diverticula, according to the experience of surgeons, were not only innate, but also hereditary, a character which certainly witnessed to their phylogenetic significance. These dorsal diverticula of the œsophagus, which occurred only pathologically in man, were a regular occurrence in another mammal, the sow. In swine, therefore, among the mammalia, just as in diodonts and tetrodonts among fish, were found both protrusions of the intestinal tube, the supra-intestinal and the infra-intestinal, existing beside each other, the most indubitable proof of their heterology. Prof. Albrecht proposed calling the dorsal protrusion the swimming bladder, and the ventral the vocal bladder.—Dr. Kossel had from pancreas extract obtained a new base, which belonged to the group of bases obtained by him from the contents of animal and vegetable cells, guanidine, xanthine, and hypoxanthine. From an analysis of 75 kilogrammes of pancreas extract he had procured, besides guanidine and hypoxanthine, a hitherto unknown base, which he was able to separate from the two and obtain in fine crystals. With hydrochloric and sulphuric salts it likewise gave fine large crystals. By reason of its occurrence in the pancreas, Dr. Kossel had called this new base "adenine;" its chemical composition corresponded with the formula $C_5H_5N_5$: it was, therefore, polymeric with hydrogen cyanide, and held the same relation to hypoxanthine, $C_5H_4N_4O$, that guanidine, $C_5H_5N_5O$, did to xanthine, $C_5H_4N_4O_2$. Later on he succeeded in authenticating the presence of adenine in the spleen likewise, as also in yeast, so that this base, too, appeared to have a more general diffusion. Adenine appeared to have an important physiological significance, on account of its composition. It had hitherto been assumed that urea must be derived from a cyanic compound, though such had not been able to be traced in the bodily tissues. Adenine, therefore, in consideration of its constitution, would seem to have some relation to formation of urea, a conjecture which further investigations might settle.—Prof. Bu Bois-Reymond laid before the Society monstrous hoofs of horses and bovine animals sent from the Falkland Islands to the Physiological Institute, which from their massiveness and the turning in of the horny material would, by their appearance, hardly be recognised for the hoofs of horses and bovine cattle.

CONTENTS

1885

esented
e diver-
urrence
position
rticula,
innate,
ssed to
of the
, were
swine,
tetro-
intes-
existing
rology.
swim-
Kossel
longed
animal
From
ad pro-
known
obtain
alts it
ence in
e;" its
H_8N_8:
, and
that
on he
spleen
red to
ave an
mposi-
erived
to be
sidera-
ion to
gations
Society
m the
from
aterial
oofs of